

14-00000

MHI
Copy 3

OPY

Supers. by FM 6-10 (MARCH 70)

FM 6-10

DEPARTMENT OF THE ARMY FIELD MANUAL

FIELD ARTILLERY COMMUNICATIONS

PROPERTY OF
QUARTERMASTER LIBRARY
U.S. ARMY QUARTERMASTER SCHOOL
RESERVED
FOR HISTORICAL USE ONLY



HEADQUARTERS, DEPARTMENT OF THE ARMY
APRIL 1965

TAGO 7852-A—March

FIELD MANUAL }
No. 6-10 }

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 2 April 1965

FIELD ARTILLERY COMMUNICATIONS

	Paragraphs	Page
CHAPTER 1. INTRODUCTION.....	1-5	3
2. GENERAL.....		
Section I. General.....	6-9	4
II. Communication in assembly areas.....	10, 11	5
III. Communication during marches and halts.....	12, 13	5
IV. Communication during attack, reorganization, and pursuit.....	14-19	5
V. Communication during defense.....	20, 21	6
VI. Communication during retrograde movements.....	22-24	7
CHAPTER 3. DUTIES OF COMMUNICATION PERSONNEL.....	25-38	8
4. MEANS AND PRINCIPLES OF COMMUNICATION.....		
Section I. Means of communication.....	39-45	11
II. Principles of communication—establishment and responsibility.....	46-53	13
CHAPTER 5. COMMUNICATION SECURITY.....		
Section I. General.....	54-57	15
II. Cryptographic security.....	58-61	16
III. Physical security.....	62-65	17
IV. Transmission security.....	66-73	17
V. Authentication.....	74-78	19
CHAPTER 6. SIGNAL ORDERS AND INSTRUCTIONS.....	79-84	22
7. THE FIELD MESSAGE.....	85-88	24
8. MESSAGE CENTER OPERATION.....		
Section I. General.....	89-93	28
II. Handling outgoing messages.....	94, 95	33
III. Handling incoming messages.....	96-98	34
CHAPTER 9. RADIOTELEPHONE PROCEDURE—CONDUCT OF FIRE.....	99-105	35
10. RADIO/WIRE INTEGRATION PROCEDURE.....	106-108	44
11. TELEPHONE AND SWITCHBOARD PROCEDURE.....	109-112	47
12. TRAFFIC DIAGRAM AND LINE ROUTE MAP.....	113-115	50
13. COMMUNICATION EQUIPMENT.....		
Section I. Introduction.....	116-118	53
II. Wire equipment.....	119-144	53
III. Radio equipment.....	145-171	69
CHAPTER 14. COMMUNICATION SYSTEMS.....	172-177	94
15. SIGNAL MAINTENANCE.....	178-181	121
APPENDIX I. REFERENCES.....		123
II. SYMBOLS.....		125
INDEX.....		128

*This manual supersedes FM 6-10, 7 March 1962.

CHAPTER 1

INTRODUCTION

1. Purpose and Scope

This manual is a guide for commanders, staff officers, and personnel concerned with field artillery communication. The purpose is to provide, in a detailed but nontechnical explanation, the basic knowledge required in the application and employment of efficient field artillery communication. Throughout this manual the term "artillery" means "field artillery."

2. Application

a. Unless otherwise specified, this manual is equally applicable to nuclear or to nonnuclear warfare.

b. This manual should be used in conjunction with appropriate references indicated throughout this manual and in appendix I.

3. Changes or Comments

Users of this manual are encouraged to submit recommended changes or comments to improve the manual. Comments should be keyed to the specific page, paragraph, and line of the text in which the change is recommended. Reasons should be provided for each comment to insure understanding and complete evaluation. Comments should be forwarded direct to Commandant, U.S. Army Artillery and Missile School, ATTN: AKPSIPL, Fort Sill, Okla.

4. References

Appropriate publications pertaining to communications are listed in appendix I.

5. Symbols

A list of symbols used in this manual are shown in appendix II.

CHAPTER 2

GENERAL

Section I. GENERAL

6. Introduction

The ability of artillery to render effective fire support depends on efficient communication. The artillery commander must rely on his communication system in controlling elements of his command, in gathering information and distributing intelligence, and in coordinating the fires of his units. Responsibility for communication rests with the commander at each echelon. The commander exercises this responsibility through his staff communication officer, who prepares communication plans and orders and directs and supervises the installation, operation, and maintenance of the communication system. The training of organic personnel in the use of the various communication means is also the responsibility of the communication officer. In addition, he supervises communication security within the unit, assumes responsibility for the on-line and off-line cryptographic equipment, and supervises the electronic countermeasure activities of the unit.

7. Area Communication Systems

The area communication system, installed by the Signal Corps, is used to augment artillery communication systems and as an alternate means of communication. In short, the area system offers a means for expeditiously establishing a wire network between artillery elements when the length of lines required is beyond the capabilities of the units to establish or maintain. When the primary use of the area system is the handling of logistic and adminis-

trative traffic, artillery units sometimes use the area system on a common-user basis. However when the artillery uses the area system as a means for transmitting fire control traffic, sole-user circuits are provided. The artillery communication officer must be provided with early information of impending displacements in order to complete the necessary liaison with the agency responsible for displacing the area system stations. For detailed information on operation of area systems, see appropriate field manuals in the 11-series.

8. Priority of Installation

In the establishment of artillery communication systems, priority of installation is given to elements of the system concerned with fire support and fire direction. During movements and in the initial phase of position occupation, reliance is placed on radio, but wire circuits are installed to parallel radio channels as soon as the situation permits.

9. Communication Planning

Communication planning is a continuous operation which begins with the commander's estimate of the situation. This phase of planning is conducted concurrently with operational planning, and is coordinated with the planning of the other staff officers. Communication planning follows the normal phases of staff planning described in FM 101-5. Communication plans include all details necessary to clarify and coordinate the signal activities of the affected units, such as wire recovery, radio retransmission, and sole-user circuits.

Section II. COMMUNICATION IN ASSEMBLY AREAS

10. General

In assembly areas, all echelons receive information concerning contemplated operations and make their plans accordingly. Staff conferences are held for coordination of effort. Command posts are organized so that communication and personnel requirements may be held to a minimum.

11. Tactical Application of Communication

During the occupation of the concentrated area, communication is provided as follows:

a. Message centers are established and operated by each headquarters. Messengers are stationed at each message center and scheduled messenger service may be provided if the volume of traffic warrants.

b. Wire installations are held to a minimum within the concentration area.

c. Radio stations generally are silenced or restricted except for warning nets. All radio sets are serviced and tested on channels prescribed for the planned operation by the SOI and SSI.

d. All signal equipment is inspected for operating condition and adequacy. Equipment shortages are replenished.

e. Training is continued and intensified. Emphasis is placed on requirements for the particular operation being planned.

f. Prearranged message codes are prepared and distributed.

Section III. COMMUNICATION DURING MARCHES AND HALTS

12. Communication During Marches

a. During marches, communication facilities are used for column control and for contact with reconnaissance and security parties and with supported and higher units.

b. A march message center is established by each headquarters in one of the leading vehicles of the column. Normally, messengers are used between march units and within groups and serials of individual march units.

c. Wire communication is impractical; however, wire teams may precede the column to the future area to install wire communications, remain behind to recover wire from the old area, or both.

d. If radio communication is not prohibited for security reasons, each artillery unit operates on its command/fire direction channel. All vehicular radios operate on this channel for rapid dissemination of information and orders. Battalion commanders and separate battery commanders operate also in the next higher headquarters command/fire direction net, FM. Divisional light aircraft and artillery reconnaissance and security parties maintain radio communication with the marching columns.

13. Communication During Halts

During temporary halts, communication is maintained as during the march. The use of messengers and radio (if not restricted) is continued.

Section IV. COMMUNICATION DURING THE ATTACK, REORGANIZATION, AND PURSUIT

14. General

a. When the supported force is committed, the artillery must be ready to provide continuous support. Meteorological messages, warning orders, and other preparatory information are disseminated to the units as rapidly as possible. Consequently, the communication system must be developed rapidly to accomplish these missions.

b. In certain stages of an engagement, control of the artillery may be decentralized. To give the force commander a mass of firepower with which to in-

fluence the action, however, centralized control is resumed as soon as the situation permits.

15. Command Posts

To effect the necessary centralization of command, artillery command posts are established to coordinate all the artillery fires of the force. Continuous communication is maintained between the command posts of the artillery and of the supported units. Initial installations may be expanded into more elaborate systems. For example, during the preparation for the attack of an organized position,

time is usually available to permit a more detailed communications installation.

16. Displacement of Command Posts

a. In making a displacement, using wire communication, the general plan indicated in FM 6-20-1 is followed. Regardless of whether or not displacement is accomplished by echelon, communications must be maintained with the command post of the supported unit throughout.

b. Since displacement by echelon presents many difficulties, communication plans made before the attack include the possibility that all means of communication other than radio may be temporarily impractical. The primary consideration in this situation is that communication must be maintained between the forward and rear echelons, as well as with the forward observers and liaison officers. Ordinarily, displacing echelons of an artillery battalion use the battalion command/fire direction channel.

17. Tactical Application of Communication During the Attack

The artillery commander prescribes to what extent the wire and radio systems of the units are to be developed in any tactical situation. Initially, communication is by radio and messenger, but wire communication is provided as rapidly as possible. Although speed is essential during the development of the attack, communication security is vital. Since radio traffic is a source of information to the enemy, it is held to a minimum. Messages sent by radio are brief, and the rules of communication security are observed (see chapter 5, and ACP 122-series, and FM 32-5). Maximum use is made of authorized codes. (See chapter 14 for typical wire systems and radio nets.)

Section V. COMMUNICATION DURING DEFENSE

20. General

a. In a prepared defense, enough time is available for the planning and installation of a complete wire system. Radio may not be utilized initially, but all nets are established and operators maintain listening watch. Wire communication is provided for liaison officers and forward observers. Duplicate circuits should be established, using different wire routes if possible. Wire is installed to alternate positions to facilitate early communication if these positions are occupied.

b. Particular attention is given to the maintenance

18. Communication During Reorganization

a. After an attack has reached its objective or has been stopped short of the objective, the force commander may decide to continue the attack, to withdraw, or to defend. In any event, forces are regrouped to fit the new plan of action, and communication systems are reorganized and altered to fit the new plans.

b. The reorganization phase is critical for artillery communication. Artillery support is continuous, to protect the supported units and to assist in stopping counterattacks. Artillery communication officers maintain existing communication systems and prepare to extend or modify them as soon as a new decision is made. Radio nets continue in operation.

c. In preparation for a displacement, communication officers insure that signal equipment is salvaged, serviced, and repaired, and they assist in the redistribution of equipment within the units.

19. Communication During Pursuit

a. The artillery is usually attached to the unit making the pursuit. The maintenance of communication is more difficult because of the speed of the operation and increased distances between units. Reliance must be placed on radio communication.

b. Rapid movement requires rapid and frequent displacement. Maintenance of contact between units and between a unit's advance and rear command posts requires message center personnel, messengers, other communication personnel, and appropriate signal equipment at each installation.

c. When an artillery unit displaces by echelon, the first echelon includes radio sets for communication in command and fire direction radio nets. Messengers with transportation are maintained as needed at message centers. Aircraft may be used for drop and pickup service.

and improvement of wire circuits. Wire routes that afford maximum natural cover and concealment are selected regardless of distance. Wire is installed with great care, and improvement of the wire system is continuous.

21. Lateral Communication

Lateral circuits should be established between units to provide coordination and alternate circuits for emergencies. Authority to use commercial or other circuits already in existence is obtained from the division signal officer.

Section VI. COMMUNICATION DURING RETROGRADE MOVEMENTS

22. General

Communication procedures during retrograde movements generally are similar to those used in forward displacements. The artillery communication officer obtains information regarding routes of withdrawal on which he bases the withdrawal communication plan.

23. Planning Communication

The communication officer is prepared to submit a plan for using existing communication facilities to the best advantage during the withdrawal. On receipt of the necessary information for the plan of withdrawal, he plans the communication system to be used by subordinate units. The plans include—

a. Provisions for strict regulation of radio operation which may include silencing certain stations or establishing dummy stations, as needed, for deception.

b. A plan for the most effective use of existing wire circuits.

24. Communication During Displacements

a. Communication personnel continue the operation of existing systems while preparing for displacement.

b. If the situation permits, wire not required by units is recovered. When time does not permit complete recovery, the abandoned wire lines should be cut in several places.

c. Radio listening silence is normally maintained during retrograde movements. For the purposes of deception and with approval of higher headquarters, the normal level of radio traffic may be maintained at the old position.

d. All practical means of communication are used. Existing wire circuits between the old and new positions are used. Messenger service is available at all times.

CHAPTER 3

DUTIES OF COMMUNICATION PERSONNEL

25. General

The tables of organization and equipment (TOE), from the highest echelon of artillery to battery level, authorizes communication personnel whose primary duties are to install, operate, and maintain communication systems. Artillery units of battalion size and larger are authorized a communication officer as a member of the commander's special staff.

26. Communication Platoons

a. *General.* Each artillery battalion and higher headquarters is authorized a communication platoon normally organized as shown in figure 1.

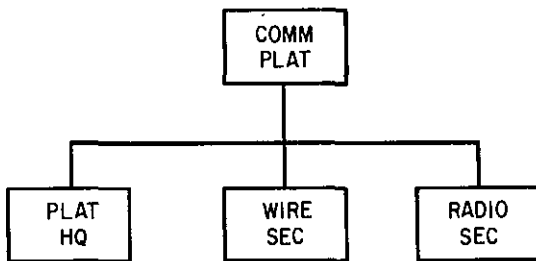


Figure 1. Organization of communication platoon.

b. *Platoon Headquarters.* The communication platoon headquarters generally consists of the assistant communication officer, who commands the platoon; the communications chief, radio mechanics, an agent and the message center personnel. In units that are not authorized an assistant communication officer, the communication chief is in charge of the platoon.

c. *Wire Section.* The wire section includes a section chief, wire teams, and switchboard operators, the numbers depending on the type of unit.

d. *Radio Section.* The radio section includes a section chief and sufficient radio operators and radio teletypewriter operators to operate the equipment organic to the section.

27. Communication Personnel in Other Sections

In some units, radio and radio teletypewriter operators are assigned to sections other than the communication platoon. Although each operator functions in the section to which he is assigned, the radio chief should supervise his training and performance.

28. Battery Communication Sections

The battery communication section generally consists of a communication chief, wire teams, and switchboard operators, the number depending on the type of unit.

29. Duties of the Communication Officer

a. The communication officer is a member of the commander's special staff. Although staff officers may prepare and transmit orders to subordinate units, they do so only as representatives of, and in the name of, the commander. The scope of this authority is determined by the commander's policy.

b. As a representative of the commander, the communication officer has the following responsibilities:

- (1) *Reconnaissance.* Recommends location of command post and its major elements in coordination with S3 and headquarters battery commander.
- (2) *Plans.* Plans the communication system of the unit with attached and supported units; plans displacements.
- (3) *Direction and supervision.* Directs and supervises the installation, operation, and maintenance of the communication system of the unit.
- (4) *Adviser to Commander and Staff.* Advises the commander and staff of pertinent electrical countermeasures and antijamming techniques.

(5) *Administration.*

- (a) Prepares communications SOP, prearranged message codes, and communication portions of orders.
 - (b) Submits reports, line route maps, etc., to higher headquarters.
 - (c) Advises S4 on supply matters pertaining to signal equipment.
- (6) *Liaison.* Contacts communication officers of superior, subordinate, reinforcing, reinforced, and adjacent units to coordinate and to improve communication.
- (7) *Training.* Plans and supervises all communication training in the unit.
- (8) *Inspections.* Conducts technical inspections of signal equipment.

30. Duties of Assistant Communication Officer

The duties of the assistant communication officer are as follows:

- a. General.* Assists the communication officer in all his functions.
- b. Direction and Supervision.* Exercises direct supervision over the installation, operation, and maintenance of all communication equipment installed by headquarters battery. Supervises maintenance of equipment in headquarters battery. Commands the communication platoon.
- c. Administration.* As executive officer of headquarters battery, assists headquarters battery commander in battery administration.
- d. Training.* Conducts the training of the communication platoon.

31. Relationship Between Headquarters Battery Commander, Communication Officer, and Assistant Communication Officer

- a.* The assistant communication officer is the assistant, or second in command, to the communication officer and, if he is executive officer of headquarters battery, to the headquarters battery commander.
- b.* The headquarters battery commander and the communication officer must cooperate on such matters as--
 - (1) Assignment of communication personnel.
 - (2) Training of communication personnel.
 - (3) Supply and maintenance of equipment.
 - (4) Selection of installations within the command post area.
 - (5) Use of communication personnel.

32. Duties of Communication Chief

- a.* Takes personal charge of the installation of all communication means established by his unit and supervises its operation and maintenance.
- b.* Assists in the conduct of instruction and in the training of the communication platoon or section.
- c.* Keeps himself informed of all communication aspects of artillery operations.
- d.* When appropriate, performs duties of assistant communication officer.
- e.* Coordinates all communication within the command post.
- f.* Supervises message center operations.
- g.* Supervises and coordinates, under the direction of the communication officer, organizational maintenance of signal equipment within the battalion.

33. Duties of Chief Message Clerk and/or Senior Message Clerk (Battalion and Higher Headquarters)

- a.* Installs and operates message center.
- b.* Keeps message center records.
- c.* Trains and supervises message clerk and messengers.
- d.* Processes messages delivered to message center.
- e.* Encodes and decodes messages.
- f.* Enciphers and deciphers messages.

34. Duties of Message Clerk (Code Clerk)

Performs all duties required of senior message clerk except those mentioned in paragraph 33c.

35. Duties of Wire Section Chief

- a.* Reconnoiters wire routes.
- b.* Plans wire systems.
- c.* Takes personal charge of the installation, operation, and maintenance of all wire intalled by headquarters battery.
- d.* Trains wire section personnel.
- e.* Serves as communication chief during the latter's absence.

36. Duties of Wire Team Chief

- a.* Selects wire routes.
- b.* Assists in the preparation of line route maps.
- c.* Installs and maintains wire lines.
- d.* Trains wiremen and telephone and switchboard operators.
- e.* Serves as wire section chief during the latter's absence.

37. Radio Section Chief

- a. Selects locations of the elements of the radio and panel stations.
- b. Organizes the radio system at the command post.
- c. Trains members of the radio section.
- d. Reports to message center any change in the status of radio communication.
- e. Assists communication chief in supervising organizational maintenance of radio equipment with the unit.

38. Communication Teams

a. All communication personnel must be able to perform duties of other members of the section, operate switchboard and radiotelephone equipment, use SOI and SSI, operate motor vehicles, and act as messengers.

b. All personnel listed in paragraphs 29 through 37 function as members of teams. They must be trained in the basic military subjects of sanitation, field fortifications, camouflage, local security, maintenance of equipment, etc. The communication teams and their general capabilities are listed below.

(1) *Message center team.*

- (a) Clears messages through message center without delay.
- (b) Plans and executes synchronization of time.
- (c) Maintains record of signal operation instructions, and changes thereto, and distributes them promptly to the interested agencies.
- (d) Knows the status of communication at all times in order to utilize available means most efficiently.
- (e) Encrypts and decrypts messages.

- (f) Safeguards cryptographic systems and equipment.

(2) *Wire section.*

- (a) Prepares the unit wire plans in conjunction with the assistant communication officer.
- (b) Establishes wire communication with minimum delay, using proper procedures and coordinates the activities of wire personnel of subordinate units.
- (c) Cooperates with wire personnel of superior, subordinate, adjacent, and supported units to maintain continuous communication.
- (d) Maintains uninterrupted wire communication during displacements, when practicable.
- (e) Works closely with unit message center.
- (f) Observes rules of transmission security.
- (g) Negotiates difficult terrain, using simple pioneer methods.
- (h) Notifies message center of any change in status of wire communication.

(3) *Radio section.*

- (a) Prepares the unit radio plan in conjunction with the assistant communication officer.
- (b) Establishes radio stations promptly when the time and place for opening nets is indicated.
- (c) Coordinates the activities of radio personnel of subordinate units.
- (d) Enforces net discipline and transmission security.
- (e) Assumes the entire traffic load of the unit at any time.
- (f) Functions as a panel team.
- (g) Works closely with unit message center.
- (h) Notifies message center of any change in status of radio communication.

CHAPTER 4

MEANS AND PRINCIPLES OF COMMUNICATION

Section I. MEANS OF COMMUNICATION

39. General

Within field artillery units, the means of communication available are radio, wire, messenger, visual, and sound. The composition of the means in each unit depends on the personnel, equipment, and transportation provided by its table of organization and equipment and by the unit or higher commander. The various means of communication have different capabilities and limitations and, consequently, they are employed so that they complement each other and so that total dependence is not placed upon any one means. The reliability of communication systems is greatly increased by the use of all the means available. However, the failure of one, or all, available electronic means does not relieve a commander of his communication responsibility. In brief, the means employed in a given situation are generally those that provide the maximum reliability, flexibility, security, and speed.

40. Wire Communication

a. General. Wire is one of the artillery's principal means of communication and includes the use of field telephone wire, cable assemblies, wire laying and recovery equipment, battery-operated and sound-powered telephones, switchboards, teletype-writers, and associated equipment. It affords person-to-person conversation with break-in operation (capability of interrupting the conversation). Wire generally affords more security than radio communication, but the security of classified information is never assured when transmitted in the clear. The decision to establish wire communication depends on the need for it, the time available to install and use it, and the capability to maintain it. The supply of wire on hand, the expected resupply, and future needs are also considered. Wire communication can be used over most terrain and in most situations. Tables of organization and equipment provide units with equipment to install and

maintain their wire communication systems. For the employment of wire communication in various units, see chapter 14.

b. Range. Using a battery-operated telephone, the planning range of field wire circuits is from 22 to 35 kilometers (14 to 22 miles). Using sound-powered telephones, the range is 5 to 16 kilometers (4 to 10 miles). In short, the range of wire communication varies, depending principally on the weather and the condition of the wire. Wet weather, poor splices, and damaged insulation reduce the range appreciably.

c. Time Required for Installation. More time is required to install wire communication than for any other means, depending mainly on the length of the line and the method of laying (vehicle, aircraft, or man-pack) other factors to be considered in estimating the installation time are the personnel available, their training, the terrain, routes, weather, and visibility.

d. Installation.

- (1) Wire lines are usually laid by wire teams. One man on foot can lay a short wire line by using a wire dispenser or light reeling equipment. Across bodies of water or unusually difficult terrain, wire may be laid from dispensers attached to light aircraft or attached to a rocket and fired over an obstacle. For details on laying wire from a dispenser, see TM 11-2240.
- (2) A wire line is generally laid on the ground parallel to a road with 15- to 20-percent slack. Lines may be strung overhead in areas such as command posts where it is impracticable to bury the lines or leave them lying on the ground. In crossing roads, wire is buried, constructed overhead, or placed under bridges and through culverts. Areas in which wire is likely to be damaged by traffic or enemy fire are avoided. Part of a wire team lays the

wire and the remainder of the team polices it (throws it off the road, makes road crossings, etc.). The laying of a line is not delayed for policing however, except at critical points.

e. Switchboards. Switchboards are used to increase the flexibility of the wire systems and to reduce the number of wire lines needed. The line capacities of the switchboards vary.

f. Use of Telephones. Telephones are reserved for occasions when there is a need for discussion and speed. To insure that calls will be brief and to facilitate the entry of messages in the unit or staff journal, the essential parts of a message should be reduced to writing before a conversation begins. During critical periods the use of telephones may be restricted to designated personnel, except for emergency calls.

g. Use of Teletypewriter. In some artillery units teletypewriters are used in wire or radio circuits to transmit messages. This equipment furnishes both parties a written record of the messages exchanged.

41. Radio Communication

a. General. Since radio is a principal means of communication, a sufficient number of radios are provided to make radio communication available to all commanders and key staff officers. Additional radios are provided for command posts, for fire control, and for other uses. All radio sets issued within the field artillery are capable of voice operation. Radios are also provided for communication between aircraft and from air to ground. The types of radio equipment organic to artillery units is discussed in chapter 13. For the employment of radio communication in various units, see chapter 14.

b. Capabilities and Limitations. Radio communication is subject to natural interference (static), interference from other radio stations, and deliberate interference (jamming) by unfriendly forces. Its reliability depends largely on the skill of the operators. The tactical situation and the characteristics of the radio sets dictate their employment. The most important characteristics of the radio sets used in field artillery units are shown in chapter 13. To be capable of operating together, radio sets must have a common or overlapping frequency range, be of the same type of modulation, and transmit and receive the same type of signal, and the stronger set must be kept within the transmitting range of the weaker set. The operating ranges shown in chapter 13 are for average conditions; the ranges obtained may be more or less, depending on the skills of the

operators, the weather, the terrain, the interference, and the locations from which the sets are operated. Powerlines and steel structures close to operating sites reduce operating ranges.

42. Messenger Communication

a. General.

- (1) Messenger communication is a supplementary means available to all units. The efficiency of messenger service depends on the selection and training of the individuals who serve in this capacity.
- (2) Messenger communication is the most secure of all the means of transmission. It is flexible and reliable; its speed depends on the mode of travel, which may be by foot, motor vehicle, or aircraft. It is the only means available within field artillery units for transmitting maps and documents. Messenger service has some limitations, however. It is vulnerable to enemy action in forward areas and does not afford person-to-person conversation.
- (3) Messengers are used when security dictates or when delivery by messenger is faster than other means. Messenger service is an effective means for delivering long messages over short distances.

b. Types of Messenger Service. Scheduled messenger service is established when locations are fixed and the amount of traffic warrants a fixed schedule. Special messengers are employed whenever required by the urgency of the message. Messenger relay posts may be established when messages are carried frequently between the same points or units and when, because of the distance, difficulties of terrain, or hostile activity, other messenger service is ineffective.

43. Visual Communication

a. General. Visual communication is a supplementary means of communications that is available to all units. Visual signals in field artillery units are generally limited to panels, arm-and-hand signals, and other prearranged visual signals, such as pyrotechnics and the maneuver of aircraft. These visual means are suitable for transmitting prearranged messages rapidly over short distances. However, these visual signals are easily misunderstood. They are vulnerable to interception and the enemy may use similar signals to deceive or to create confusion.

Their use is restricted during periods of poor visibility or when line-of-sight locations are not available; in addition, they may be prohibited for security reasons.

b. Panels. Two general types of panels are issued for communication with aircraft: marking and identifying panels and panels for transmitting messages. Marking and identifying panels are made in bright fluorescent colors. They may be used to mark positions and identify units as friendly. Black and white sets of panels for transmitting messages are issued for use on light and dark backgrounds, respectively. They are used to transmit brief messages or to identify a particular unit. The combined panel system and panel recognition code, which is included in the unit SOI and FM 21-60, is used for this type of visual communication.

44. Sound Communication

Sound is also a supplementary means of communication that is available to all units. Sound signals

are transmitted by whistles, bugles, horns, gongs, klaxons, weapons, and other noisemaking devices. They are used chiefly to attract attention, transmit prearranged messages, and spread alarms; they are kept simple to prevent misunderstanding. They serve as a rapid means of communication over short distances. On the other hand sound signals are very vulnerable to interception, and their use may be prohibited for security reasons. Their range and reliability are greatly reduced by battle noise.

45. Integration of Wire and Radio Communication Systems

Wire and radio have been discussed as two separate and distinct means of communication. In operations, they may be closely integrated by using radio-wire integration equipment and radio relay equipment. For details pertaining to remote control equipment and the interconnection of radio and wire systems, see TM 11-486-series. For procedure to be used with radio/wire integration, see chapter 10.

Section II. PRINCIPLES OF COMMUNICATION—ESTABLISHMENT AND RESPONSIBILITY

46. General

The responsibility for the establishment of communication at various echelons of command is defined in AR 105-15 and in paragraphs 47 through 51, but variations may occur depending on the tactical mission of a unit.

47. Superior to Subordinate

The commander of a higher echelon or superior unit is responsible for the establishment and maintenance of communications to a unit of a lower echelon or a subordinate unit. Attached units are subordinate to the command to which attached.

48. Supporting to Supported

The commander of a supporting unit is responsible for the establishment and maintenance of communications to the supported unit.

49. Reinforcing to Reinforced

The commander of a unit reinforcing the fires of another artillery unit is responsible for the establishment and maintenance of communications to the reinforced unit.

50. Lateral Communication

Responsibility for the establishment of lateral

communication between adjacent units may be fixed by the next higher commander or may be established in the standing operating procedure (SOP). In the absence of specific orders fixing the responsibility, the commander of the unit on the left is responsible for establishing communication with the unit on the right.

51. Internal Communications

The commanding officer of each unit is responsible for the installation, maintenance, and operation of the internal communications of his command.

52. Maintenance

Effective maintenance requires the close coordination and joint participation of all units concerned. If communication is disrupted, its reestablishment is the joint duty of all units affected, although the responsibility remains with the unit that is responsible for installing the line.

53. Practical Application of Principles of Communication

a. The principles set forth in paragraphs 47 through 51 clearly define the responsibility for establishing and maintaining communications. Such responsibility cannot be delegated but can be

transferred from one commander to another when so ordered by a higher commander.

b. The installation of communications is not necessarily accomplished by the unit of the responsible commander. It often becomes necessary for the

responsible commander to delegate the actual installation of communications to subordinate units. Such practice is not a deviation from established principles, since only the physical installation is delegated, not the command responsibility.

CHAPTER 5

COMMUNICATION SECURITY

Section I. GENERAL

54. Definition

Communication security is the protection resulting from all measures designed to deny unauthorized persons information of value which might be derived from a study of our communications. Communication security includes transmission security, cryptographic security, and physical security.

55. Responsibility

a. Communication security is a command responsibility. However, every individual engaged in the preparation of material for transmission or the actual transmission of material is responsible for compliance with procedures governing preparation, transmission, and safeguarding of communications.

b. In carrying out his communication security responsibilities, the commander is normally assisted by the intelligence officer, who plans, coordinates, and exercises staff supervision over security matters within the command, and by the communication officer. To fulfill his responsibility for communication security, the commander must—

- (1) Maintain a continuous control system to account for classified information, equipment and material.
- (2) Conduct periodic and thorough inspections to determine the adequacy of physical security measures for the protection of classified information and cryptographic equipment and material and to insure that cryptosystems are properly used.
- (3) Develop adequate emergency plans including emergency destruction plans.
- (4) Consider communication security requirements in all operation planning.

- (5) Take remedial action to eliminate causes of communication security violations.

c. Responsibility rests with each person of the command to assist the commander in fulfilling his task. The security consciousness of the individual is an important factor, since communication systems cannot overcome the effect of carelessness. Discussion of classified information with unauthorized personnel or in inappropriate places constitutes a great hazard to security. Therefore, it is the responsibility of the individual to report any apparent violation of, or weakness in, communication security to his superior.

56. Security Classification

Security classification is based on the degree of danger to national security which would result from unauthorized disclosure of military or official information. The classification system establishes a standard of care for handling, storage, and dissemination of information belonging to each classification. Security classifications are discussed in detail in AR 380-5 and AR 380-6.

57. Security Measures

Security measures for the protection of military information, equipment, and material include defense against capture, salvage, theft, espionage, observation, photography, interception, direction finding, traffic analysis, cryptanalysis, and imitative deception. High standards in training will preclude carelessness and laxity of personnel. It is of utmost importance that all personnel remain alert at all times to provide adequate protection of defense information, equipment, and material.

Section II. CRYPTOGRAPHIC SECURITY

58. Definition

Cryptographic security is that part of communication security which deals with the proper use of authorized codes, cipher devices, and machines used for encrypting and decrypting messages. For detailed information on the handling of cryptographic material, see AR 380-40, AR 380-40-1, AR 380-41, AR 380-46, and KAG-1()/TSEC. The following cryptographic systems are available to most artillery units:

a. *Prearranged Message Code.* The prearranged message code may be prepared at any echelon by the communication officer for use within that unit. Such codes must be prepared in accordance with approved instructions to prevent their being compromised. For further information on the preparation of such codes, see KAG-21/TSEC.

b. *Operations Code.* The operations code is prepared at division or higher level by the signal officer and is used extensively throughout the command, down to and including battalion headquarters. See KAG-21()/TSEC.

c. *Map Reference and Numeral Cryptosystems.* Map reference and numeral cryptosystems are tactical codes used to encode and decode map coordinates and other numbers. See KAG-21()/TSEC.

d. *Cipher Machines and Devices.* On-line and off-line cipher equipment will be available to most units requiring such equipment. Additionally, speech security equipment is found in artillery units organized under E series or later TOE.

59. Sending Messages in Clear Text

a. Army regulations require that all classified messages be transmitted in cryptographic form unless during actual hostilities the urgency of the message does not permit encrypting and the enemy will not have sufficient time to act upon the information contained in the message. The exception to this rule concerns messages classified TOP SECRET; they are *never* transmitted in the clear over electrical means. In order to send a classified message in the clear, such transmission must be authorized by the commanding officer or his authorized representative.

b. The rule in a above does not apply to messages which are not normally encrypted, such as enemy contact reports. Non-nuclear fire missions are normally transmitted in clear text. The speed required and the number of personnel involved preclude encrypting these messages if fire on given targets is to be delivered in time.

c. In an effort to conceal the contents of unclassified messages transmitted by electrical means they should be encrypted for transmission. When this technique is used the abbreviation EFTO (encrypted for transmission only) will be used in place of the security classification in the message format.

60. Compromise, Loss, or Possible Compromise

a. An essential part of cryptosecurity is the prompt reporting of possible or actual compromise of cryptomatter. Such prompt action is necessary so that cryptomaterial determined to have been compromised may be withdrawn from further use and information encrypted with the compromised systems may be reviewed and necessary action taken. This report should contain as much of the following information as is applicable:

- (1) Nature of violation.
- (2) Identity (publication, system, or equipment).
- (3) Length of message(s).
- (4) Date-time group.
- (5) Means of transmission.
- (6) Originator and addressee.

b. In the event of loss or physical compromise subsequent to the initial report, a thorough investigation will be made and a complete report will be sent through appropriate channels to the controlling authority for the cryptomaterial concerned.

61. Clearance of Personnel

a. No person is entitled to knowledge or possession of classified material solely by virtue of his grade. Such material will be entrusted only to those individuals whose official or government duties require such knowledge. All persons whose duties require access to classified material must be cleared to receive classified information.

b. Formal authorization for access to crypto information is required. Subject to local regulations, commanders may grant such access in accordance with AR 604-5. Before granting such access the commander must review the individual's 201 file or official personnel folder, as appropriate, to verify that the following forms have been executed:

- (1) DA Form 873 (Certificate of Clearance and/or Security Determination Under EO 10450).

- (2) DD Form 98 (Armed Forces Security Questionnaire) or DA Form 1111 (Statement of Nonaffiliation with Certain Organizations), as appropriate.

- (3) DA Form 2545 (Cryptographic Access Authorization, Briefing and Debriefing Certificate).

Section III. PHYSICAL SECURITY

62. Definition

Physical security is that portion of communication security pertaining to the physical measures necessary to safeguard classified communication equipment and material from access by unauthorized persons. For details on safeguarding, distributing, and accounting for cryptomaterial, see AR 380-40, AR 380-41, and KAG-1()/TSEC.

63. Need for Physical Security

a. Unsuspected physical compromise is far more serious than known loss. If an undisclosed compromise occurs and the cryptosystem continues in use, an enemy may be able to decrypt all traffic sent in that system. Protection against physical compromise can be accomplished by observing the following precautions:

- (1) Proper handling by all personnel concerned.

- (2) Adequate storage when not being used.

- (3) Complete destruction when required.

b. Effective physical security insures the maximum protection of classified material from production to destruction.

64. Routine Destruction of Classified Material

Certain nonregistered, classified material is destroyed when directed by competent authority. All such material will be destroyed by burning, if possible.

65. Emergency Destruction of Classified Material

As far as humanly possible, classified material will not be permitted to fall into enemy hands. Emergency destruction should be carried out as described in AR 380-5, AR 380-40, and KAG-1()/TSEC.

Section IV. TRANSMISSION SECURITY

66. Definition

Transmission security includes all measures designed to protect transmissions from interception, traffic analysis, and imitative deception.

67. Means of Transmission

Users of communication systems should select the means most appropriate to the delivery of messages in accordance with the specified precedence and security requirements. Means and types of transmissions available are—

- a. Messenger.
- b. Mail.
- c. Approved wire circuits.
- d. Nonapproved wire circuits.
- e. Visual.
- f. Sound.
- g. Radio.

Note. For more information concerning the means of transmission listed in a through g above, see FM 32-5 and ACP 122(B).

68. Message Preparation

a. Transmission security within a command can be greatly enhanced when personnel directly concerned with message preparation are familiar with the fundamentals of transmission security. Such personnel include the—

- (1) *Message originator*—The commander by whose authority messages are sent.

- (2) *Writer*—The person who prepares a message.

b. Although all messages are sent in the name of the commander, few are likely to be written by him personally. It is, therefore, of utmost importance that a commander insure that the message writers within his command know the principles of communications security. For details pertaining to message preparation, see chapter 7. In fulfilling his responsibilities, the writer must consider the following:

- (1) Only communications that require rapid transmission for the accomplishment of a military objective are prepared for transmission by electrical means.

- (2) Messages prepared for transmission by electrical means should be short and concise.
- (3) Each message should be assigned the proper precedence, depending on the importance of the message and requirements for rapid delivery. Improper precedence can cause overloaded communication facilities and increase the possibility of transmission security violations.

69. Radio Intelligence

Radio intelligence consists of all measures taken by the enemy to obtain intelligence from our radio communications. *Strict radio silence is the primary defense against radio intelligence.* Interception and direction finding can be made more difficult by—

- a. Avoiding unauthorized transmissions and unnecessary testing, thus decreasing the opportunities for direction finding.
- b. Using a combination of transmitters, antennas, and power to produce minimum wave propagation and emission intensity consistent with reliable communications.
- c. Using the broadcast method of transmitting traffic whenever possible in preference to the receipt method.
- d. In the absence of a prearranged plan, concealing the instructions to shift frequency by encryption.
- e. Adjusting the transmitter accurately, adhering to the authorized frequency, and maintaining strict circuit discipline.

70. Operator Training

Operating and maintenance personnel must be trained to recognize and avoid the following practices which endanger communication security:

- a. Violation of radio silence.
- b. Unofficial conversation between operators.
- c. Transmitting in a directed net without permission.
- d. Excessive repetitions of prosigns or operating signals.
- e. Use of plain language in place of applicable prosigns or operating signals.
- f. Use of unauthorized prosigns.
- g. Incorrect and unauthorized procedure.
- h. Identification of unit locations.
- i. Failure to maintain radio watches on designated frequencies and at prescribed times.
- j. Identification of individuals belonging to an organization.

k. Transmitting at speeds beyond the capabilities of receiving operators.

l. Use of excessive transmitting power.

m. Consuming excessive time in tuning, testing, changing frequency, or adjusting equipment.

n. Improper use of call signs.

71. Jamming

Enemy jamming is the transmission of disturbing radio signals to interfere with the reception of the desired signal. The effects sought by the enemy are to disrupt our system and deny its use to our forces. Techniques employed to minimize the effects of jamming are called antijamming. The term "electronic counter-countermeasures" (ECCM) includes antijamming.

a. All radio frequencies are vulnerable to jamming, and the enemy will jam radio reception whenever it is advantageous. To accomplish this, he will select the frequencies to be jammed, tune a transmitter to that frequency, and transmit a strong signal to obscure reception of the desired signal.

b. There are two sources of interfering signals, external and internal. If the disturbance heard in the receiver can be eliminated or substantially reduced by grounding or disconnecting the receiving antenna, it may be assumed that the trouble is being caused by some external source. If the disturbance remains unchanged when the antenna is disconnected or grounded, the set is not functioning properly. If interference is caused by some external source, a further check must be made to determine whether the cause is enemy jamming or accidental interference.

c. In most instances, antijamming measures will go beyond the efforts of operators. The enemy can jam all radio circuits. Therefore, until jam-proof equipment and techniques are developed, all possible steps must be taken to minimize the effects of enemy jamming. It is imperative that the radio operator continue to operate his set during enemy jamming attacks. The skill of the radio operator determines his ability to work effectively through jamming. He should remain calm and persist in applying the proper anti-jamming techniques and procedures. Most current radio relay equipment has been designed with built-in antijamming features.

d. A prompt, accurate, and complete report of enemy jamming is important, since an enemy jamming attack is usually part of a well-organized plan and frequently precedes important tactical maneuvers. The reports from the individual radio

operators, which frequently provide intelligence on the extent and importance of enemy action, are normally compiled at division or corps headquarters by electronic warfare personnel. Properly correlated jamming information may serve as a warning of impending enemy action in a sector or on a broad front.

72. Telephone Security

It is most important for users of the telephone to understand the relative security inherent to different types of circuits. Even if the circuits are cleared for transmission of classified material, they must still be used with extreme care. Just as the chain is as strong as its weakest link, it is the weakest part in the overall telephone circuit that determines the security of the overall circuit. When an overall telephone connection contains weak links (such as a simple two-wire telephone circuit near the front, a

simple two-wire circuit among unfriendly inhabitants, or a radio link circuit in a telephone system employed under similar conditions), there is no communications security even though the major part of the overall circuits is secure. For this reason, a high degree of telephone discipline must be observed by telephone users in a system.

73. Monitoring

Radio monitor stations set up by central control agencies under area or higher commands are a vital factor in attaining the most effective overall circuit discipline and operator efficiency. Violations of transmission and crypto security and deviations from prescribed procedures may be discovered by monitoring, and reported to the responsible stations, together with suitable references, instructional material, and log excerpts.

Section V. AUTHENTICATION

74. General

Authentication is a communication security measure which protects against imitative communication deception. The authentication system used within a command will be specified by the commander concerned. Those systems which may be locally prepared are described in detail in KAG-24/TSEC, a nonregistered, confidential crypto publication of the Department of Defense. It is distributed through established cryptographic issuing authorities and does not require the establishment of a cryptographic account.

75. Procedures

a. Transmission of Authenticators. In radio telegraph procedure, when the authenticator is a single character, instructions should specify that it be transmitted twice. In voice transmissions, phonetic equivalents of the alphabet letters are to be used (see effective edition of ACP 125).

b. Selection of Test Elements. When transmission authentication is authorized for use, local instructions shall specify that one of the test elements shall be selected from the message heading and another from the text.

- (1) In counting the letters of the text to reach a designated test element, classification designations, indicators, locally prescribed designators (such as "unclassified") and exercise words, including "exercise" and

"drill" (and any characters used to separate such words from the text) shall not be considered part of the text and shall not be counted.

- (2) In the event of a brief message, the text shall be recounted as many times as necessary to reach the required letter.
- (3) If a designated test element is a slant (/) sign, the letter X shall be substituted for it and shall be used as the test element.

c. Use of Time Elements.

- (1) Local instructions should specify whether the date-time group of the message or the time of current transmission is to be used.
- (2) If an authentication system which requires the use of time elements is used in more than one time zone, a common time or GMT must be specifically prescribed to prevent confusion and re-use of a time element.

76. Transmission Authentication

By this method a calling station's validity may be established without requiring any transmission from the called station. The test elements used by the calling station are selected by prearrangement according to the specific authentication system in effect.

a. On voice circuits, the authenticator is transmitted immediately preceding the ending proword, prefixed by the phrase "authentication is".

Example: BRAVO FOXTROT—THIS IS SIX HOTEL EIGHT—AIR DROP REQUESTED—TIME ONE FOUR ONE FIVE ZULU—AUTHENTICATION IS VICTOR PAPA—OVER

b. On radio telegraph circuits, the authenticator is transmitted immediately preceding the ending prosign, prefixed by the operating signal "ZNB".

Example: BF3 DE 6H8 BT AIR DROP REQUESTED BT 1415Z ZNB VP K

77. Challenge and Reply Authentication

Upon receipt of a challenge, the challenged station uses the challenge to obtain an authenticator in accordance with the operating procedure for the individual authentication system. The challenger must also go through the process of determining the authenticator to ascertain that the reply as received is correct.

a. On voice circuits:

- (1) The challenge is transmitted after the call, preceded by the phrase "What is authentication of . . . ?"

Example: BRAVO FOXTROT THREE—THIS IS SIX HOTEL EIGHT—WHAT IS AUTHENTICATION OF INDIA TANGO—OVER

- (2) The reply is similarly transmitted, preceded by the phrase "Authentication is . . ."

Example: SIX HOTEL EIGHT—THIS IS BRAVO FOXTROT THREE—AUTHENTICATION IS NOVEMBER—OVER

- (3) The reply should include a counterchallenge if the authenticity of the challenging station is in doubt.

Example: BRAVO FOXTROT THREE—THIS IS SIX HOTEL EIGHT—AUTHENTICATION IS NOVEMBER—WHAT IS AUTHENTICATION OF ALFA OSCAR—OVER

b. On radio telegraph circuits:

- (1) The challenge is transmitted after the call, preceded by the operating signal "INT ZNB".

Example: BF3 DE 6H8 INT ZNB IT K

- (2) The reply is similarly transmitted, preceded by the operating signal "ZNB". It may be followed by a counterchallenge.

Example: BF3 DE 6H8 ZNB NN INT ZNB AO K

Note. On receipt of a challenge, the challenged station should not request a stand-by unless essential for operational reasons. If a stand-by is requested, the challenger should send a second challenge with different test elements when communication is resumed.

78. Net Authentication

Authentication of an entire net may be required when opening the net. Although the challenge and reply method may be used for this purpose, the use of predetermined net test groups provides a means whereby expeditious authentication of all stations in the net may be accomplished.

a. *Predetermined Net Test Groups.* When net authentication procedure which includes the use of net test groups is to be employed, a list of predetermined net test groups and their effective periods will be prescribed in local command communications instructions. The net test groups will be groups of random letters from which test elements will be taken. The net test groups will be selected by the authority compiling the communications instructions and will provide exclusive groups for each net in operation. Accompanying instructions will designate which letters from each group will be used as the test elements. The method of selecting test elements will be the same for each net test group in a single edition of an instruction. Each net test group in the list is numbered serially, and a list of the net test groups is provided each station in the net. These net test groups will be used in order, and each group will be crossed out when used, in order to prevent re-use. Only the serial number of the net test group is transmitted, never the group itself. A time group may be included if necessary.

b. *Procedure.* Either of the procedures outlined below may be used for net authentication. Local instructions shall specify which procedure is in effect.

- (1) The net control station (NCS) transmits a net test group serial number and a derived authenticator (or authenticates itself by transmission authentication), and then transmits a challenge. Subordinate stations will answer in the alphabetical order of their individual call signs. The first

station checks to see that the authentication of the NCS is correct, replies to the challenge issued by the NCS, and transmits a challenge to the next station. Each station reports into the net by answering the challenge sent out by the station preceding it in alphabetical order, and by sending out a challenge to the next station. The net call sign is used by each station when transmitting its challenge to the next station. When all stations have properly reported, the net is open.

- (2) The NCS and each station in the net, in alphabetical order of call signs, transmits serial numbers of net test groups (in sequential order) and the authenticators derived therefrom.

c. Incorrect Authentication.

- (1) If an incorrect net test group serial number or authenticator is transmitted by the

NCS, the first station to answer transmits "ZND2", meaning "You are using authentication incorrectly; check authentication of your last transmission." The serial number of the correct net test group may then be transmitted by the challenged station, following which the NCS begins the self-authentication and challenge procedure again.

- (2) If any subordinate station gives an incorrect authentication, the NCS will wait until all stations have reported into the net, at which time it will transmit a challenge directly to the offending station. If a correct answer is received, the station is authenticated, and the net is open. If an incorrect answer is received, the NCS should then send the net call sign and the operating signal "ZNC2", which means "All transmissions will be authenticated on this circuit".

CHAPTER 6

SIGNAL ORDERS AND INSTRUCTIONS

79. The Operation Order

a. General. The operation order is a means by which a commander directs his organization in an operation. In some cases, because of a time limitation, it may be impossible to prepare complete written signal estimates and plans. Therefore, it sometimes becomes necessary that paragraph 5 (the signal portion) of the operation order be prepared on the basis of the communication officer's estimate and plan. The signal portion may be issued orally. The signal portion of the operation order must be issued in sufficient time to permit the installation of the required communication systems before the beginning of the action concerned. For details on paragraphs 1, 2, and 3 of the operation order, see FM 101-5.

b. Paragraph 4, Administration and Logistics. Details of signal supply and repair may be included in paragraph 4 of the operations orders as follows:

- (1) Special priority of signal troops or vehicles on roads.
- (2) Locations of signal depots.
- (3) Signal distribution points.
- (4) Special instructions concerning the issue of signal supplies.

c. Paragraph 5, Command and Signal. The extent of the communication instructions and information contained in paragraph 5 of the operation order depends on the decision of the unit commander. Paragraph 5 may contain the index number and issue number of the signal operations instruction (SOI) which is in effect, or it may be expanded to include reference to the signal annex (if one is included) or to repeat important instructions of the signal annex or SOI. It may also contain other information of importance that is deemed necessary or desirable by the commander; e.g., location of subordinate command posts, axis of signal communication, location of advance message centers, restrictions on the use of equipment and pyrotechnics, and the date and hour of radio net opening.

80. Signal Annex

The signal annex to an operation order is prepared when the signal instructions are too voluminous to be included in paragraph 5 of the operation order. It is based on the signal plan and is made as short as possible by referencing routine signal instructions contained in the standing operating procedures. The signal annex, which follows the format of the operation order, includes information and instructions that directly affect signal support. A signal annex becomes a part of the commander's operation order, even though it may be distributed at a different time and receive different distribution. A comprehensive SOP and SOI-SSI will minimize the need for a signal annex.

81. Standing Operating Procedure

An SOP (standing operating procedure) is a set of instructions giving the procedure to be followed by a particular unit in performing those operations, both tactical and administrative, that the commander desires to be routine.

a. Purpose of a Signal Standing Operating Procedure. The purpose of a signal standing operating procedure is to—

- (1) Gain speed and precision in operations by standardizing the operating methods, procedures, and techniques.
- (2) Simplify and perfect the training of all personnel.
- (3) Reduce the number and length of signal orders.
- (4) Simplify staff planning.
- (5) Facilitate control and coordination of effort at all levels of command.
- (6) Promote teamwork.
- (7) Enable all members to understand what the rest of the unit will do under certain circumstances.
- (8) Reduce the number of minor decisions to be made by the commander and his subordinates.

b. Form and Content. Signal SOP's are prepared in accordance with the format described and illustrated in FM 101-5. In addition, a checklist for preparation of an artillery unit SOP is shown in FM 6-20-2. The content of the signal SOP will depend on the desires of the commanding officer, the recommendations of the communication officer, the SOP of the next higher headquarters, and the state of training of the command.

c. Flexibility. A signal SOP must be revised from time to time as the training of the unit progresses in order to eliminate superfluous details and to insure the development of concise, final instructions suitable for contemplated operations.

d. Use of the Signal SOP. The signal SOP should have widespread distribution within the unit. All key operating personnel should know the signal SOP of the unit since it affects not only communication personnel but also users of the communication systems.

82. Signal Operation Instructions

a. General. The signal operation instructions (SOI) consist of technical instructions, subject to frequent change, that are required in the employment of signal communication. The SIO is generally prepared and issued by the signal officer at a headquarters of division level and above. Radio frequencies and call signs may be assigned to corps artillery and division artilleries in blocks, and the communication officers of these units will be required to prepare an extract SOI assigning frequencies and call signs to subordinate units. Units authorized retransmission equipment should be assigned non-interfering frequencies as shown in the applicable technical manuals.

b. Distribution. Distribution of the signal operation instructions is made to subordinate units, next higher headquarters, and the headquarters of adjacent commands. Certain items of the SOI should be extracted and given wide distribution within the unit.

c. Classification. Each portion of the SOI is classified according to its content, as prescribed by AR 380-5, AR 380-40, and AR 380-6. The classification is marked or stamped at the top and bottom

of each page of the classified portion. The assembled SOI is assigned the same classification as the portion with the highest classification.

d. Security. SOI's include information that is of particular value to the enemy because it could serve as a means of gaining additional intelligence. Therefore, the complete SOI of any echelon should not be taken forward of the command post of the echelon to which it is issued. When an SOI or an extract is compromised, the fact must be reported and the SOI must be replaced immediately. For information concerning the storage of classified material, see AR 380-5, AR 380-40, and AR 380-41. A record should be maintained of all extracted portions of an SOI, and personnel within units should be instructed to destroy these items if capture is imminent.

83. Standing Signal Instructions

The standing signal instructions (SSI) contain operating instructions, not subject to frequent change, that are required in the employment of signal communications throughout the issuing command. It includes instructions that explain the various procedures to be followed in using the individual items of the SOI. When no SSI is published, these instructions are incorporated in the SOI.

a. Distribution. Items of the standing signal instructions receive the same distribution as SOI items. The signal officer may make additional distribution, when necessary.

b. Classification. The SSI is classified in the same manner as the SOI.

84. Routine Signal Orders

To insure coordination of signal communications throughout the command, it is necessary from time to time to issue routine signal orders. These orders are prepared by the staff signal officer and contain information and instructions of general and more than temporary interest. The following subjects might be covered in routine signal orders:

- a.* Changes in allowances of equipment.
- b.* Correction of abuses in the use of equipment and services.
- c.* Deficiencies in training and operations.
- d.* Standing operating procedure.
- e.* Supply and maintenance instructions.

CHAPTER 7

THE FIELD MESSAGE

85. General

a. In field artillery units, messages are usually prepared on DA Form 11-170 (message book M-210). The procedures given in this chapter apply when the message book M-210 is used and also when no message book is available and the writer must improvise a message form. For purposes of illustration, the form used in this chapter is a message blank from the message book M-210. The basic rules of message preparation and the description of elements to be entered on a message will apply to any message form.

b. Message writing is not confined to commanders or staff officers. All military personnel, regardless of grade or position, are authorized, and may be required, to write field messages.

c. This chapter describes procedures for composing a tactical message. The text of a message is the basic idea of the writer. The text must be brief, clear, and accurate. The message must be written so that the addressee knows exactly what the writer intended to convey. All unnecessary words and phrases should be omitted.

86. Basic Rules for Preparing Messages

In the preparation of a message—and this includes writing the text—certain rules must be followed.

a. *Writing.* Each word must be printed in block capital letters (except signatures which must be written in longhand).

b. *Abbreviations.* Normally, abbreviations will not be used. However, if the writer has reasonable knowledge that the addressee is familiar with certain abbreviations, those authorized by AR 320-50 may be used.

c. *Punctuation.* Punctuation should not be used unless necessary for clarity. When punctuation is necessary, the punctuation symbol itself is used. The asterisk (*), number (#), and commercial (@) will not be used. The letter X may be used when exact punctuation is not essential but separation of the text is needed for clarity.

d. *Repetition.* Repetition will not be used solely for the purpose of emphasis. It may be used to insure correct receipt of a vital word or unpronounceable series of unrelated letters. An example in which repetition serves a legitimate purpose is as follows: MIYAZAKI REPEAT MIYAZAKI (to minimize the possibility of mistaken identity or incorrect spelling).

e. *Isolated Letters.* The phonetic alphabet is used for each isolated letter. Route A, for example, must appear as ROUTE ALFA. The initials of a person's name, however, are never given the phonetic alphabet equivalent.

f. *Numbers.* Numbers may be written as numerals, or the digits may be spelled out individually. For example, 227 may be written as 227 or as TWO TWO SEVEN. Numbers of even hundreds and thousands, if spelled out, will be spelled out literally—TWO HUNDRED for 200 or ONE SEVEN THOUSAND for 17,000.

g. *Spacing.* If possible, the text should be written on every other line of the message form.

87. Message Book, DA Form 11-170 (M-210)

a. The forms contained in the M-210 message book are arranged in sets of three, interleaved with carbon paper, thus permitting every message to be prepared in triplicate. When a written message is to be routed through the message center, the number of copies sent to the message center will depend on the unit standing operating procedure.

b. The messageform is used whether the message is to be transmitted by electrical means or carried by messenger. If message book M-210 is not available, the writer may use a plain sheet of paper but the message format as discussed in paragraph 88 must still be followed.

88. Procedures for Writing the Message

Filling in the messageform involves the steps discussed in a through l below and shown in figure 2.

a. *Precedence.* The assignment of precedence to a message is the responsibility of the originator. To the writer, precedence means the required speed of delivery to the addressee. The writer determines the precedence on the basis of the contents of the message and the time factor involved. He must select the lowest adequate precedence. To communication personnel, precedence means the relative order of handling and delivery. To the addressee, precedence indicates the order in which he notes or reads a message. The four precedence designations are shown in table I. The precedence will not be taken for granted; one of the authorized designations must be used.

b. *Number.* The writer's message number is entered in the space provided after the abbreviated word "No." There are no regulations concerning the assignment of this number; each command specifies its own procedures. This is not transmitted when the message is transmitted by electrical means.

c. *Date.* The day, the month (abbreviated), and the year, in that order, are entered in the space provided after the word "Date." The first three letters of the month constitute the correct abbreviation.

d. *Official Designation of the Addressee.* The official designation of the addressee is entered in the space provided after the word "To." The addressee is normally the commander of the unit or command for whom the message is intended.

e. *Official Designation of Sender.* Enter the official designation of the originator in the appropriate block. The originator is identified as the sender in the M-210 message form. Normally, the originator is the commander (designated by title and organization) by whose authority the message is sent. He must be distinguished from the writer, who composes the text. The writer and the originator may or may not be the same person.

THESE SPACES FOR MESSAGE CENTER ONLY			
TIME FILED	MSG CEN NO.	HOW SENT	
MESSAGE (SUBMIT TO MESSAGE CENTER IN DUPLICATE) PRIORITY (PRECEDENCE)			
No. <u>6</u> Date <u>27 FEB 64</u>			
To. <u>CO 1ST BN, 17TH ARTY</u>			
CLASSIFICATION			
FOR S3			
PLAN SIERRA EFFECTIVE 280130S			
CLASSIFICATION SEND IN CLEAR <i>John A. Smutz, CAPT</i>			
OFFICIAL DESIGNATION OF SENDER <u>CO 1ST INF DIV ARTY</u>			TIME SIGNED <u>0815S</u>
SIGNATURE AND GRADE OF WRITER <u><i>Oscar F Foley</i></u> LT COL, S3			

Figure 2. Completed field message.

TIME FILED	MSG CEN NO.	HOW SENT
MESSAGE (SUBMIT TO MESSAGE CENTER IN DUPLICATE)		ROUTINE (PRECEDENCE)
No. _____ Date 28 FEB 64		
To LO *I, 1ST BN, 17TH ARTY		
UNCLASSIFIED		
REPORT YOUR LOCATION		
UNCLASSIFIED		
S-3, 1ST BN, 17TH ARTY OFFICIAL DESIGNATION OF SENDER		09465 TIME SIGNED
SIGNATURE AND GRADE OF WRITER <i>Henry A Davis, MAJOR, S3</i>		

Figure 3. Example of a message when the writer and the addressee are both on the same commander's staff.

f. *Originator, Writer, and Addressee on the Same Commander's Staff.* When the writer and the person for whom the message is intended are on the same commander's staff (fig. 3): for example, the S3 of a unit sends a message to the liaison officer of the same unit, *d* and *e* do not apply.

Table I. Precedence Designations

Precedence designation	Example of use
FLASH.....	Flash precedence is reserved for initial reports of enemy contact or operational combat messages of extreme urgency.
IMMEDIATE.	Reports amplifying initial enemy contact. Urgent intelligence and/or operational combat messages.
PRIORITY....	Reports of warning of grave natural disaster (earthquake, flood, storm, etc.). Messages concerning the conduct of operations in progress. Urgent administrative messages.

Table I. Precedence Designations—Continued

Precedence designation	Example of use
ROUTINE....	Messages concerning normal peacetime military operations. Operational plans concerning projected operations.

Note. The above four precedences have been approved for joint U.S. use. Allied countries may use six precedences—FLASH, EMERGENCY, OPERATIONAL IMMEDIATE, PRIORITY, ROUTINE, AND DEFERRED. When correspondence is with allied nations, EMERGENCY would be transmitted after FLASH and before IMMEDIATE. OPERATIONAL IMMEDIATE would be transmitted after IMMEDIATE and before PRIORITY. DEFERRED would be transmitted after ROUTINE.

g. *Security Classification.* AR 380-5 requires that the security classification be indicated at the top and bottom of a classified item. The proper security classification—TOP SECRET, SECRET, CONFIDENTIAL, CONFIDENTIAL—MODIFIED HANDLING AUTHORIZED, or UNCLASSI-

IFIED—is entered above and below the text of the message. The classification is circled to separate it from other elements of the message. If the message contains cryptoinformation, it will be marked in accordance with AR 380-40.

- (1) The originator is responsible for the security classification of the message (originator is identified as the sender in the M-210 message form), but the writer is responsible for determining the proper security classification of the message in the name of the originator. No assumptions can be made about security. The writer must separately and independently designate the security classification of each message.

- (2) The message center will not accept a message that has not been identified and marked with its security classification. This applies to both tactical and administrative messages. In an emergency, a message with a classification up to and including SECRET may be sent in the clear. Only the commanding officer or his specifically authorized representative can authorize a message to be sent in the clear. Before a classified message can be sent in the clear, the following conditions must exist:

- (a) The unit must be engaged in actual hostilities.
- (b) Speed is so essential that time cannot be taken to encode the message.
- (c) The transmitted information cannot be acted on by the enemy in time to influence current operations.

h. Encrypted for Transmission Only.

- (1) In the interest of transmission security, it is sometimes necessary to encrypt certain unclassified messages to prevent disclosure of their textual contents. Such messages requiring this protection are designated EFTO (encrypted for transmission only).
- (2) If a message writer is applying the EFTO procedures, the abbreviation UNCLAS EFTO is marked or stamped immediately above and below the text of the message in the M-210 message form.

i. Text. The text of a message must be clear, accurate, and brief. As few words as required for clarity will be used in the message. Conjunctions, prepositions, and articles, such as *a, but, for, in, on, and the*, should be eliminated unless essential to the meaning. The text of a message consists of two parts, the internal instructions and the body.

- (1) *Internal instructions.* The internal instructions may consist of any required additional addressee and originator designations (para 87 and 88) and will begin on the first line of the body of the message form. The word “for” will be used to indicate that the message should be delivered to a specific officer or individual at the location addressed. It is followed by an abbreviated title of the person or office within the agency, command, or installation for whom the message is intended.
- (2) *Body.* The body of the message is the basic idea of the writer. The body of the text will follow the internal instructions.

j. Time Signed. The writer will enter the time he signed the message. If he signs the message on the same day shown in the date block, he will enter only the hour, minute, and zone suffix. If the two dates differ, he will enter the complete date-time group to show the day of the month, the hour, and the zone suffix.

- (1) A sample date-time group is 211415Z. The first two digits (21) indicate the 21st day of the current month. (Two digits are always shown; for days prior to the 10th, a zero is added before the digit. For example, the seventh day would be shown as 07.) The second two digits (14) indicate the hour, and the last two digits (15) indicate the minutes after the hour; Z is a suffix indicating the time zone.
- (2) The TIME SIGNED block should bear a time zone suffix to indicate the time zone used. The theater commander may authorize the local suffix for messages that will not leave the time zone in which the theater is located. In other instances, the theater commander may require the use of Greenwich mean time.

k. Signature and Grade of Writer. The writer signs his name and grade in the block provided.

l. Authorized To Be Sent in the Clear. Each classified message to be transmitted in the clear must be authorized separately by the commanding officer or his specifically authorized representative. This authorization is indicated by the statement “send in clear” followed by the signature and grade of the authorizing person. This statement is circled to separate it from the other elements of the message. If no signature appears, the message will be encrypted prior to transmission by electrical means.

CHAPTER 8

MESSAGE CENTER OPERATION

Section I. GENERAL

89. General

The message center of a headquarters is the communication agency which receives, transmits, and delivers messages of record for the commander and the staff of the headquarters which it serves. The message center for a headquarters of an artillery unit is operated by organic communication personnel. The commander is responsible for establishing message center procedures which will best meet the needs of his unit and yet conform to the specific requirements established by his higher headquarters. Accuracy and speed are the results desired in formulating an operating procedure for the message center. However, security will not be sacrificed to gain speed.

90. Organization

a. The tables of organization and equipment (TOE) for artillery units provide for personnel to operate a message center. These personnel are the—

- (1) *Chief message clerk and/or senior message clerk.* The chief and/or senior message clerk supervises all activities of the message center to include cryptography, receipt, transmission, and delivery of all messages processed through the message center.
- (2) *Message clerk.* The duties of the message clerk are the same as those of the senior message clerk. He normally acts as code clerk when both he and the senior message clerk are present in the message center.
- (3) *Messenger.* The messenger assists in the operation of the message center. His main duty is to pick up and deliver messages as required.

b. Although not specifically provided by TOE, certain other personnel are required by duty assignment to work in the message center and should be trained in message center procedures. These personnel are—

- (1) *Messengers.* Assigned personnel are detailed as messengers.
- (2) *Operators.* Radio and teletypewriter operators are trained in cryptography to assist in processing messages requiring encryption or decryption when message center personnel are not available and to insure 24-hour operation.

91. Forms and Equipment

Efficient message center operation depends on certain forms, publications, and equipment. The operation of the message center may be simplified by using the minimum required recording procedures and the maximum communication facilities available to the unit. The required forms are listed in a through c below. These forms facilitate message handling and are used when available.

a. *Message Book, DA Form 11-170.* DA Form 11-170, Message Book, provides a set of blank message forms for writing or recording messages. It is normally referred to as message book M-210.

b. *Joint Messageform, DD Form 173.* DD Form 173, Joint Messageform, is used for messages originating within a headquarters for transmission over the on-line crypto facilities of a communication center. When a message requires more than one page, DD Form 173-1, Joint Messageform—Continuation Sheet, is used.

c. *Communication Center Delivery List, DA Form 11-39.* DA Form 11-39, Communication Center Delivery List (fig. 4), may be used as a receipt form for delivery of messages within one's own headquarters. The message may be delivered directly to an individual or to the distribution center in the headquarters.

92. Files and Records

Elaborate records must be avoided. However, pertinent classified and unclassified publications

(FM 24-17; TM 11-490-1)

Staff Message Control

08 March 61

[illegible]

DA FORM 11-39
1 SEP 54

EDITION OF 1 OCT 49 WILL BE USED UNTIL EXHAUSTED

* GPO : 1962 O - 647139

Figure 4. Communication center delivery list (DA Form 11-39).

governing the operation of mechanical and electro-mechanical cipher devices and the control of associated material must be on hand. All message center personnel must be familiar with the instructions included in these publications, and responsible commanders must insure strict compliance with these directives. Additional records that may be required are listed in *a* through *f* below.

a. Live File. The duplicate clear text copy or skeleton copy of each outgoing message processed by the message center is placed in the live file. This copy remains in the live file until a receipt is obtained from the receiving headquarters. It is then indorsed and placed in the dead file.

b. Dead File. The dead file consists of the duplicate copies of all receipted outgoing messages and completed receipt forms. This file is turned over to the S1 or other designated person by the communication officer at frequent intervals (usually daily) so that messages may be included in the unit journal or other official records of the headquarters.

c. Message Clerk's File. The message clerk retains on file the original clear text copy of each outgoing cryptogram and the original cryptographed copy of each incoming cryptogram. Care must be taken to insure that the clear text and the cryptographed copy of a single message are never filed together. These files are disposed of as directed by the communication officer. The message crypto log is maintained by the message clerk or teletypewriter (or radio teletypewriter) operator who, in certain circumstances, is the cryptographer. The crypto log is maintained separately for incoming and outgoing messages and reflects messages transmitted and received electrically. This log is used in submitting the encrypted traffic report. The log is disposed of on instructions of the security officer in accordance with AR 345-210 and AR 380-40.

d. Operator's File. The file kept by the radio and teletypewriter operators will contain a copy of each

message sent or received. The file will be disposed of as directed by the communication officer.

e. Communication Status Log. The Communication Status Log (DA Form 2150-R) is a record maintained by the message center which shows the current availability of all means of communication used by the message center. It is used to determine the best available routing for messages. The operators of the various communication facilities keep the message center informed of the status of communication with other units. The Communication Status Log, DA Form 2150-R (fig. 5), will be reproduced locally on 8- by 10½-inch paper. The log is closed out at 2400 hours daily and a new log opened at 0001 hours. Only existing available communication is shown on the new log. The old log is placed in the dead file.

f. Message Center Log. The Message Center Log (DA Form 2151-R) is a daily chronological record of all messages handled by the message center. A separate log is maintained for incoming and outgoing messages. The logs are closed as of 2400 hours daily. Any message not yet receipted for must be checked to insure that the message has been received by the addressee. When all messages have been cleared, the log is placed in the dead file. The Message Center Log, DA Form 2151-R (fig. 6), will be reproduced locally on 10½- by 8-inch paper.

93. Unit Cryptocustodian and Cryptosecurity Officer

The unit cryptocustodian and cryptosecurity officer should have a detailed knowledge of the regulations governing the maintenance of cryptographic records, reports, and physical security requirements. These officers must be thoroughly familiar with the following partial list of references: AR 380-5, AR 380-40, AR 380-40-1, AR 380-46, and AR 345-210. In addition, there may be other classified documents, depending on the type of equipment issued to the unit.

COMMUNICATION STATUS LOG										DATE		
UNIT					TIME ZONE					PAGE NO.		NO. OF PAGES
UNITS TO WHICH CONNECTED	AM RAD		FM RAD		TT		TEL		VHF		REMARKS	
	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT		

DA FORM 2150-R, 1 Dec 64

Replaces edition of 1 Aug 58

Figure 5. Communication status log.

[illegible]

DA FORM 2151-R, 1 Dec 64 Replaces edition of 1 Aug 58

Section II. HANDLING OUTGOING MESSAGES

94. Outgoing Messages by Special Messenger (Clear Text)

a. *Origin.* The outgoing message is prepared by the writer and submitted to the message center in sufficient copies.

b. *Processing.* The message center clerk enters the *time filed*, *message center number*, and *how sent* in the spaces provided on all copies of the message form. The duplicate skeleton copy is placed in the live file. A delivery list (fig. 7) is prepared when the original is ready for delivery.

[illegible]DA FORM 11-63
1 DEC 87

EDITION OF 1 APR 48 IS OBSOLETE.
GPO : 1955 O-450231

Figure 7. Route delivery list (DA Form 11-63).

c. Dispatch of Messages. The delivery list and the messages for delivery are given to the messenger. Prior to dispatch, the messenger should be instructed concerning—

- (1) The route to follow.

- (2) The importance of the message (if applicable).
- (3) Whether or not to wait for an answer to the message.
- (4) Other information concerning the delivery of the message.

d. *Message Center Log Entry.* After dispatching the messenger, the senior message clerk uses the duplicate or skeleton copy to record the message in the outgoing message center log.

e. Delivery of the Message. When the special messenger arrives at the addressee's unit, he delivers the message to the message center and obtains the signature of the message center clerk on the delivery list. Prior to departing, the messenger inquires if there are any messages for his unit.

f. Recording Receipt of Message. When the delivery list (receipt) is returned to the message center, the message center clerk removes the duplicate or skeleton copy of the message from the live file, enters the time of the receipt and his initials on the message, and circles these entries. He attaches the duplicate or skeleton copy to the delivery list and places both in the dead file. He closes the outgoing log entry pertaining to the message by entering the time of delivery in the time of receipt column.

**95. Outgoing Message by Electrical Means
(Encrypted)**

a. Origin. The message is prepared by the writer and submitted to the message center in sufficient copies.

b. *Processing.* The message clerk enters the *time filed, message center number, and how sent* in the spaces provided on the copies of the message. The original copy of the message is retained by the message clerk for encrypting. The duplicate or skeleton copy is given to the senior message clerk for entering the message in the outgoing message log; then the duplicate copy is placed in the live file.

c. *Security Procedure.* The message text is encrypted by the message clerk, using the *off-line* cipher machine or, in an emergency, the operations code. A copy of the encrypted text is entered on a message form together with the time filed, *message center number, how sent, and date-time group.* Radio call signs or routing indicators are placed on the message in lieu of the clear designation of the originator and addressee. The proper authentication and group count are also placed on the message, which is then sent to the operator for transmission. The

clear text original copy is placed in the message clerk's file. Worksheets and other material related to the message are destroyed by burning. The senior message clerk is notified of the group count and this information is entered on the outgoing message log. The message clerk makes the necessary entries in the outgoing crypto log, and the tapes are retained in compliance with AR 345-210.

d. Transmission. The message is transmitted by the operator to the addressee. When the addressee

station receipts for the message, the operator places his initials and the time of receipt on the message. He notifies the message center of the time of receipt and places the message in his operator's file.

e. Recording the Receipt. On receiving the time of receipt from the operator, the message clerk removes the duplicate or skeleton copy from the live file, indorses it, completes the entry in the outgoing message log, and files the copy in the dead file.

Section III. HANDLING INCOMING MESSAGES

96. Incoming Message by Messenger

a. Receipt of Message. On receiving a message delivered by a special or scheduled messenger, the senior message clerk signs the receipt form and indicates the time received.

b. Processing. The senior message clerk makes the proper entries in the incoming message log, prepares a delivery list, and dispatches the message or messages to the addressee or appropriate staff officer. When the receipt is returned to the message center, he enters the time of receipt in the incoming message log.

97. Incoming Message by Radio

a. Receipt. The operator copies the incoming messages in triplicate on the message form. After receipting for the message to the transmitting station, the operator places his initials and the time of receipt on the message. He files the triplicate copy in his operator's file and forwards the original and duplicate copies to the message center.

b. Processing. The message clerk decrypts the message and copies the clear text version on a message form. The originator and addressee are determined from the radio call sign and entered on the clear text version. Authentication is checked and noted on the message form with the time of receipt by the operator and the initials of the person who decrypted the message. The original encrypted copy is placed in the message clerk's file. The clear text copy is delivered and recorded in the incoming message log as indicated in paragraph 91. All worksheets and extra copies of the message are destroyed by burning. The message clerk makes the appropriate entries in his classified file.

98. Garrison and Field SOP

The commander must be assured that all message center personnel are familiar with the operational procedures of his message center. To aid the commander in this respect, the communication officer prepares a garrison SOP and a field SOP for message center operations.

CHAPTER 9

RADIOTELEPHONE PROCEDURE—CONDUCT OF FIRE

99. General

Radiotelephone procedure is used by all branches and services for command, operations, and administration. The artillery, however, also uses its communication system for conduct of fire. A specific radiotelephone procedure known as the short-phase, repeat-back method is used for this purpose. Although this conduct of fire procedure may be modified according to the type of fire mission, the basic procedure remains unchanged.

100. Deviations From Normal Procedure

The radiotelephone procedure for the adjustment of artillery fire deviates from the normal communication procedure outlined in ACP 125 and allied publications. Specific deviations are—

a. Limited use of procedure words and divergence from the normal message format. New meanings are given to some procedure words. For example, the word OVER indicates the end of this transmission; another station is expected to transmit next. The word WAIT indicates the end of this transmission, but the same station is expected to transmit next.

b. Extensive use of clear or modified clear text.

c. Automatic read back without the transmission instructions "read back."

d. Elimination of call signs after identities have been established and when no confusion will result. Under certain circumstances, when identification is required, transmissions are identified by the use of call sign suffix numbers only.

101. Automatic Read-Back Method of Transmission

To facilitate the transmission of firing data and

to minimize requests for repetition, transmissions may be made in short phrases. Each phrase is repeated by the receiving operator exactly as it was received. The length of each phrase or the number of elements of firing data included in each transmission should be commensurate with established procedure and the training and experience of the operators. To insure accuracy, the transmitting and receiving operators must be familiar with the sequence of the conduct of fire.

102. Net Organization

a. Four frequency modulated (FM) channels are normally allotted to a division howitzer battalion performing a direct support mission. These four channels will be assigned as a command/fire direction net (CF), fire direction net 1 (F1), fire direction net 2 (F2), and fire direction net 3 (F3). Since the command/fire direction channel is not primarily intended for fire direction, it will not be discussed further in this chapter. Each battery operates on a separate fire direction net, which includes a base set at battalion, a liaison officer, and three forward observers.

b. Stations normally concerned with the conduct of fire are—

- (1) Each forward observer and air observer.
- (2) Each liaison officer.
- (3) The base sets in the battalion fire direction center (FDC).
- (4) Each battery fire direction center.
- (5) A relay station, when necessary.

c. A fire mission may be conducted by using any combination of radio and wire. This discussion will include examples of fire missions conducted by radio only.

103. Sequence of Short-Phrase, Repeat-Back Transmission

a. *Initial Fire Request.* The radiotelephone operator for a forward observer (PALM CRIMSON 24) operating on fire direction net 1 (F1) calls the F1 base set operator (PALM CRIMSON 18) in the battalion fire direction center to inform the battalion fire direction center that he has a fire mission.

Forward observer's operator	PALM CRIMSON 18—THIS IS PALM CRIMSON 24—FIRE MISSION—OVER
F1 base set operator	PALM CRIMSON 24—THIS IS PALM CRIMSON 18—SEND YOUR MISSION—OVER

If a fire mission is already being conducted on fire direction net 1 the battalion S3 may direct the forward observer to change to fire direction net 2 or fire direction net 3. Having been directed to send his mission, the radiotelephone operator for the forward observer transmits the initial fire request in short phrases, omitting call signs when only one mission is being sent on that channel.

Forward observer's operator	COORDINATES 4322—OVER
F1 base set operator	COORDINATES 4322—OVER
Forward observer's operator	3445—OVER
F1 base set operator	3445—OVER
Forward observer's operator	AZIMUTH 800—OVER
F1 base set operator	AZIMUTH 800—OVER
Forward observer's operator	TWO MACHINEGUNS—FUZE VT—WILL ADJUST— OVER
F1 base set operator	TWO MACHINEGUNS—FUZE VT—WILL ADJUST— WAIT—

b. Correction of Errors. If any error is made during the transmission or read back of any element, the operator announces CORRECTION and repeats the correct version of the element in error.

Forward observer's operator	COORDINATES 4322—OVER
F1 base set operator	COORDINATES 4332—OVER
Forward observer's operator	CORRECTION—COORDINATES 4322—OVER
F1 base set operator	CORRECTION—COORDINATES 4322—OVER

c. Battalion Fire Order. After the initial fire request is received, the battalion S3 issues the fire order, pertinent parts of which are transmitted to the forward observer. This is read back by the forward observer's operator.

F1 base set operator	BATTERY—4 VOLLEYS—CONCENTRATION BRAVO JULIETT 386—OVER
Forward observer's operator	BATTERY—4 VOLLEYS—CONCENTRATION BRAVO JULIETT 386—OVER

d. Initial Fire Commands to the Battery.

F1 base set operator	29—BATTERY ADJUST—OVER
Btry A operator	29—BATTERY ADJUST—OVER

Note. The suffix number 29 is used in this instance to inform Battery A that it is to fire this mission.

F1 base set operator	SHELL HE—LOT—HOTEL—CHARGE 5—FUZE— QUICK—OVER
Btry A operator	SHELL HE—LOT—HOTEL—CHARGE 5—FUZE— QUICK—OVER
F1 base set operator	CENTER 1 ROUND—BATTERY 4 ROUNDS—VT IN EFFECT—OVER
Btry A operator	CENTER 1 ROUND—BATTERY 4 ROUNDS—VT IN EFFECT—OVER
F1 base set operator	DEFLECTION 2765—QUADRANT 381—OVER
Btry A operator	DEFLECTION 2765—QUADRANT 381—WAIT—

When the pieces fire, the operator reports.

Note. The suffix number 29 is used to indicate who is firing.

Btry A operator	29—ON THE WAY—OVER
-----------------	--------------------

e. Subsequent Fire Requests and Fire Commands.

Forward observer's operator	29—ON THE WAY—WAIT—LEFT 100—DROP 200— OVER
-----------------------------	---

F1 base set operator	LEFT 100—DROP 200—WAIT—DEFLECTION 2784—QUADRANT 365—OVER
Btry A operator	DEFLECTION 2784—QUADRANT 365—WAIT—29—ON THE WAY—OVER
Forward observer's operator	ADD 100—OVER
F1 base set operator	ADD 100—WAIT—DEFLECTION 2787—QUADRANT 373—OVER
Btry A operator	DEFLECTION 2787—QUADRANT 373—WAIT—29—ON THE WAY—OVER
Forward observer's operator	29—ON THE WAY—WAIT—LEFT 20—DROP 50—FIRE FOR EFFECT—OVER
F1 base set operator	LEFT 20—DROP 50—FIRE FOR EFFECT—WAIT—FUZE VT—BATTERY 4 ROUNDS—DEFLECTION 2788—OVER
Btry A operator	FUZE VT—BATTERY 4 ROUNDS—DEFLECTION 2788—OVER
F1 base set operator	TIME 20.0—QUADRANT 369—OVER
Btry A operator	TIME 20.0—QUADRANT 369—WAIT—29—FIRING FOR EFFECT—OVER
Forward observer's operator	29—FIRING FOR EFFECT—OVER
Btry A operator	29—ROUNDS COMPLETE—OVER
Forward observer's operator	29—ROUNDS COMPLETE—WAIT—END OF MISSION. MACHINEGUNS SILENCED—ESTIMATE 4 CASUALTIES—OVER
F1 base set operator	END OF MISSION. MACHINEGUNS SILENCED—ESTIMATE 4 CASUALTIES, CONCENTRATION BRAVO JULIETT 386—OVER
Btry A operator	END OF MISSION—CONCENTRATION BRAVO JULIETT 386—OUT

104. Sequence of Transmissions for a Battalion Mission

a. Fire Missions. Fire requests may be initiated by any of the forward observers. The requests are transmitted over the observer's assigned frequency to the base set operator for that particular frequency.

b. Procedure. The mission illustrated in c below will be a battalion mission with Battery B the adjusting battery and with Battery A and Battery C the nonadjusting batteries. The requesting forward observer is operating on fire direction net 2 (F2).

c. Initial Fire Request. The radiotelephone operator for the forward observer (Inland Gall 44) calls the fire direction net 2 base set operator in the battalion fire direction center, stating that he has a target upon which he wishes to bring fire.

Forward observer's operator	INLAND GALL 18—THIS IS INLAND GALL 44—FIRE MISSION—OVER
F2 base set operator	INLAND GALL 44—THIS IS INLAND GALL 18—SEND YOUR MISSION—OVER

These two transmissions correspond to a preliminary call; they are the initial establishment of communication and must be made in this manner for every mission. After the forward observer has been told to send his mission, the initial fire request may be sent in short phrases.

Forward observer's operator	COORDINATES 482902—OVER
F2 base set operator	COORDINATES 482902—OVER
Forward observer's operator	AZIMUTH 5680—OVER
F2 base set operator	AZIMUTH 5680—OVER
Forward observer's operator	INFANTRY PLATOON IN OPEN—FUZE VT—WILL ADJUST—OVER

F2 base set operator

INFANTRY PLATOON IN OPEN—FUZE VT—WILL
ADJUST—WAIT—

d. Message to Observer.

F2 base set operator

BATTALION—4 VOLLEYS—CONCENTRATION ALFA
BRAVO 101—OVER

Forward observer's operator

BATTALION 4 VOLLEYS—CONCENTRATION AFLA
BRAVO 101—OVER

Note. The phrase "message to observer" is not a part of the radio transmission.

e. Initial Fire Commands. The batteries are alerted by the appropriate battalion base set operators that they are to fire the mission (Battery A is notified by F1 base set operator; Battery B, by F2 base set operator; Battery C, by F3 base set operator). All three batteries are notified simultaneously.

F2 base set operator

49—BATTERY ADJUST—OVER

Btry B operator

49—BATTERY ADJUST—OVER

F1 base set operator

29—BATTERY ADJUST—OVER

Btry A operator

29—BATTERY ADJUST—OVER

F3 base set operator

69—BATTERY ADJUST—OVER

Btry C operator

69—BATTERY ADJUST—OVER

Note. The adjusting battery is not indicated in the notification. It will become apparent which is the adjusting battery in the initial fire commands.

f. Remaining Initial Fire Commands to the Adjusting Battery.

F2 base set operator

SHELL HE—LOT XRAY—CHARGE 5—FUZE QUICK—
OVER

Btry B operator

SHELL HE—LOT XRAY—CHARGE 5—FUZE QUICK—
OVER

F2 base set operator

CENTER 1 ROUND—BATTERY 4 ROUNDS—VT
IN EFFECT—OVER

Btry B operator

CENTER 1 ROUND—BATTERY 4 ROUNDS—VT
IN EFFECT—OVER

F2 base set operator

DEFLECTION 2891—QUADRANT 360—OVER

Btry B operator

DEFLECTION 2891—QUADRANT 360—WAIT—

g. Remaining Initial Fire Commands to the Nonadjusting Batteries. While Battery B was receiving the data in *f* above on fire direction net 2, the nonadjusting batteries were receiving their initial fire commands on fire direction nets 1 and 3, respectively.

F1 base set operator

SHELL HE—LOT XRAY—CHARGE 5—FUZE VT—
OVER

Btry A operator

SHELL HE—LOT XRAY—CHARGE 5—FUZE VT—
OVER

F1 base set operator

BATTERY 4 ROUNDS—DO NOT LOAD—OVER

Btry A operator

BATTERY 4 ROUNDS—DO NOT LOAD—OVER

F1 base set operator

DEFLECTION 2976—TIME 20.0—QUADRANT 362—
OVER

Btry A operator

DEFLECTION 2976—TIME 20.0—QUADRANT 362—
WAIT—29 IS LAID—OVER

F1 base set operator

29 IS LAID—WAIT—

F3 base set operator

SHELL HE—LOT XRAY—CHARGE 5—FUZE VT—
OVER

Btry C operator

SHELL HE—LOT XRAY—CHARGE 5—FUZE VT—
OVER

F3 base set operator

BATTERY 4 ROUNDS—DO NOT LOAD—OVER

Btry C operator

BATTERY 4 ROUNDS—DO NOT LOAD—OVER

F3 base set operator

DEFLECTION 2732—TIME 19.0—QUADRANT 361—
OVER

Btry C operator	DEFLECTION 2732—TIME 19.0—QUADRANT 361— WAIT—69 IS LAID—OVER
F3 base set operator	69 IS LAID—WAIT—

h. Subsequent Fire Requests and Fire Commands (Adjustment). While the nonadjusting batteries were receiving their initial data, the adjusting battery was proceeding with the adjustment.

Btry B operator	49—ON THE WAY—OVER
Forward observer's operator	49—ON THE WAY—WAIT—RIGHT 100—ADD 400— OVER
F2 base set operator	RIGHT 100—ADD 400—WAIT—DEFLECTION 2822— QUADRANT 368—OVER
Btry B operator	DEFLECTION 2822—QUADRANT 368—WAIT—49— ON THE WAY—OVER
Forward observer's operator	49—ON THE WAY—WAIT—DROP 200—OVER
F2 base set operator	DROP 200—WAIT—DEFLECTION 2835—QUADRANT 363—OVER
Btry B operator	DEFLECTION 2835—QUADRANT 363—WAIT—49— ON THE WAY—OVER
Forward observer's operator	49—ON THE WAY—WAIT—LEFT 50—ADD 100— OVER
F2 base set operator	LEFT 50—ADD 100—WAIT—DEFLECTION 2860— QUADRANT 366—OVER
Btry B operator	DEFLECTION 2860—QUADRANT 366—WAIT—49— ON THE WAY—OVER
Forward observer's operator	49—ON THE WAY—WAIT—RIGHT 10—DROP 50— FIRE FOR EFFECT—OVER
F2 base set operator	RIGHT 10—DROP 50—FIRE FOR EFFECT—WAIT—

i. Subsequent Fire Commands (Fire-for-Effect). At this time fire-for-effect data is produced for each battery and sent to all batteries simultaneously.

(1) *For the adjusting battery.*

F2 base set operator	FUZE VT—BATTERY 4 ROUNDS—DEFLECTION 2853—TIME 20.0—QUADRANT 365—OVER
Btry B operator	FUZE VT—BATTERY 4 ROUNDS—DEFLECTION 2853—TIME 20.0—QUADRANT 365—WAIT—

(2) *For the nonadjusting batteries.*

F1 base set operator	BATTERY 4 ROUNDS—DEFLECTION 2938—TIME 20.0—QUADRANT 367—OVER
Btry A operator	BATTERY 4 ROUNDS—DEFLECTION 2938—TIME 20.0—QUADRANT 367—WAIT—
F3 base set operator	BATTERY 4 ROUNDS—DEFLECTION 2785—TIME 20.0—QUADRANT 367—OVER
Btry C operator	BATTERY 4 ROUNDS—DEFLECTION 2785—TIME 20.0—QUADRANT 367—WAIT—

j. Firing for Effect. As the batteries begin to fire for effect, they announce this on their respective fire direction nets.

Btry B operator	49—FIRING FOR EFFECT—OVER
Forward observer's operator	49—FIRING FOR EFFECT—OVER

Note. The forward observer is informed when the first round in fire for effect has been fired. If the battery which is on his frequency fires first, the forward observer reads back the transmission directly to the battery. If one of the batteries which is not on the forward observer's frequency fires first, the base set operator on the forward observer's frequency relays this information to the forward observer.

Btry A operator	29—FIRING FOR EFFECT—OVER
F1 base set operator	29—FIRING FOR EFFECT—OVER

Btry C operator	69—FIRING FOR EFFECT—OVER
F3 base set operator	69—FIRING FOR EFFECT—OVER

k. *Rounds Complete.* As the batteries complete fire for effect, they report this on their respective fire direction nets and it is read back by the base set operators. When all batteries have completed firing for effect, the base set operator working with the forward observer informs the observer that the battalion has completed its fire for effect.

Btry B operator	49—ROUNDS COMPLETE—OVER
F2 base set operator	49—ROUNDS COMPLETE—WAIT—
Btry A operator	29—ROUNDS COMPLETE—OVER
F1 base set operator	29—ROUNDS COMPLETE—WAIT—
Btry C operator	69—ROUNDS COMPLETE—OVER
F3 base set operator	69—ROUNDS COMPLETE—WAIT—
F2 base set operator	BATTALION—ROUNDS COMPLETE—OVER
Forward observer's operator	BATTALION—ROUNDS COMPLETE—WAIT—END OF MISSION—ESTIMATE 15 CASUALTIES—RE- MAINDER DISPERSED—OVER
F2 base set operator	END OF MISSION—ESTIMATE 15 CASUALTIES— REMAINDER DISPERSED—CONCENTRATION ALFA BRAVO 101—OVER

The F2 base set operator, in making the last transmission above, has in actuality made *two* transmissions; he has read back to the forward observer his transmission and initiated a transmission to Battery B, giving them end of mission and the concentration number of this mission. Battery B operator may now answer in one of two ways—he may read back exactly what the F2 base set operator has transmitted, or he may omit the forward observer's surveillance. The battery's transmission will depend on the local SOP.

Btry B operator	END OF MISSION—CONCENTRATION ALFA BRAVO 101—OUT
F1 base set operator	END OF MISSION—CONCENTRATION ALFA BRAVO 101—OVER
Btry A operator	END OF MISSION—CONCENTRATION ALFA BRAVO 101—OUT
F3 base set operator	END OF MISSION—CONCENTRATION ALFA BRAVO 101—OVER
Btry C operator	END OF MISSION—CONCENTRATION ALFA BRAVO 101—OUT

Note. The batteries terminated their transmission with the procedure word OUT because they made the last transmission on their respective fire direction nets. No further transmissions are expected or required in this mission. The procedure word OUT will normally be heard only once on each frequency for each fire mission.

105. Sequence of Transmission for Special Situations

The flexibility of conduct of fire procedure permits its modification to meet special situations.

a. *Fire for Effect, Precision Fire.* The radiotelephone procedure used in the fire for effect portion of a precision fire mission is similar to that used in adjustment except that, to avoid possible confusion, the terminating proword is eliminated when sensings are transmitted.

Forward observer's operator	49—ON THE WAY—WAIT—ADD 50, FIRE FOR EFFECT—OVER
F2 base set operator	ADD 50, FIRE FOR EFFECT—WAIT—QUADRANT 295—OVER
Btry B operator	QUADRANT 295—WAIT—49—ON THE WAY—OVER
Forward observer's operator	49—ON THE WAY—WAIT—SHORT LEFT
F2 base set operator	SHORT LEFT—WAIT—DEFLECTION 2810—QUAD- RANT 295—OVER
Btry B operator	DEFLECTION 2810—QUADRANT 295—WAIT—49— ON THE WAY—OVER

Forward observer's operator	49—ON THE WAY—WAIT—OVER LINE
F2 base set operator	OVER LINE—WAIT—DEFLECTION 2812—QUAD-
	RANT 295—OVER
Btry B operator	DEFLECTION 2812—QUADRANT 295—WAIT—49—
	ON THE WAY—OVER
Forward observer's operator	49—ON THE WAY—WAIT—SHORT LINE
F2 base set operator	SHORT LINE—WAIT—DEFLECTION 2811—QUAD-
	RANT 295—OVER
Btry B operator	BASE PIECE—3 ROUNDS—DEFLECTION 2811—
	QUADRANT 295—WAIT—49—ON THE WAY—
	OVER
Forward observer's operator	49—ON THE WAY—OVER
Btry B operator	49—ROUNDS COMPLETE—OVER
Forward observer's operator	49—ROUNDS COMPLETE—WAIT—SHORT LINE—
	OVER LINE—OVER LEFT
F2 base set operator	SHORT LINE—OVER LINE—OVER LEFT—OBSERVE
	TIME REGISTRATION—OVER
Forward observer's operator	OBSERVE TIME REGISTRATION—OVER
F2 base set operator	TIME 21.0—QUADRANT 295—OVER
Btry B operator	TIME 21.0—QUADRANT 295—WAIT—49—ON THE
	WAY—OVER
Forward observer's operator	49—ON THE WAY—WAIT—AIR
F2 base set operator	AIR TIME 21.4—QUADRANT 295—OVER
Btry B operator	TIME 21.4—QUADRANT 295—WAIT—49—ON THE
	WAY—OVER
Forward observer's operator	GRAZE
F2 base set operator	GRAZE—OBSERVE 3 ROUNDS—OVER
Forward observer's operator	OBSERVE 3 ROUNDS—OVER
F2 base set operator	BASE PIECE—3 ROUNDS—TIME 21.2—QUADRANT
	295—OVER
Btry B operator	BASE PIECE—3 ROUNDS—TIME 21.2—QUADRANT
	295—WAIT—49—ON THE WAY—OVER
Forward observer's operator	49—ON THE WAY—OVER
Btry B operator	49—ROUNDS COMPLETE—OVER
Forward observer's operator	49—ROUNDS COMPLETE—WAIT—AIR—AIR—
	GRAZE

b. Simultaneous Missions. Situations may occur in which it is necessary to send two or more fire missions simultaneously on the same fire direction net. In such cases it is necessary that stations identify their transmissions. The battalion fire direction center controls all simultaneous missions. Procedure at the battery fire direction centers does not change—they still use their suffix numbers to indicate when the batteries fire. If required, concentration numbers are used to identify a target. When a battery fires, this is announced by the battery, and the forward observer working with this battery reads back the transmission. The forward observer, when he sends his corrections, uses his suffix number (and concentration number if required) to identify the mission to which the correction applies. In the following example, one forward observer conducts simultaneous fire missions on two targets. Target 1 is identified by the concentration number AB105 and target 2 as AB106. Suffix numbers will be retained for battery identification and the concentration number to identify separate targets.

The missions are now in progress as follows:

Btry A operator	29—AB105—ON THE WAY—OVER
Forward observer's operator	29—AB105—ON THE WAY—WAIT—AB105—RIGHT
	100—ADD 100—OVER
F1 base set operator	AB105—RIGHT 100 ADD 100—WAIT—

Btry A operator	29—AB106—ON THE WAY—OVER
Forward observer's operator	29—AB106—ON THE WAY—WAIT—
F1 base set operator	AB105—DEFLECTION 3410—QUADRANT 331—OVER
Btry A operator	AB105—DEFLECTION 3410—QUADRANT 331—WAIT—
Forward observer's operator	AB106 DROP 50—FIRE FOR EFFECT—OVER
F1 base set operator	AB106 DROP 50—FIRE FOR EFFECT—WAIT—
Btry A operator	29—AB105—ON THE WAY—OVER
Forward observer's operator	29—AB105—ON THE WAY—WAIT—AB105—RIGHT 50—ADD 50—FIRE FOR EFFECT—OVER
F1 base set operator	AB105—RIGHT 50—ADD 50 FIRE FOR EFFECT—WAIT AB106—BATTERY 3 ROUNDS—DEFLECTION 3505—QUADRANT 305—OVER
Btry A operator	AB106—BATTERY 3 ROUNDS—DEFLECTION 3505—QUADRANT 305—WAIT—

The missions continue and are ended in the normal manner.

c. *Use of Splash.* In the conduct of some fire missions (always for air observer and high angle fire), SPLASH warnings are transmitted from the fire direction center to the observer 5 seconds prior to the end of the time of flight.

Btry A operator	29—ON THE WAY—OVER
Forward observer's operator	29—ON THE WAY—OVER
F1 base set operator	SPLASH—OVER
Forward observer's operator	SPLASH—WAIT—

Note. The SPLASH warning is given by the battalion fire direction center in this example because it is assumed that most missions will be controlled by battalion. If the battery fire direction center were conducting the mission, the SPLASH warning would be given by the battery. This adjustment continues in a similar manner until the observer enters fire for effect. SPLASH warning is given for the first round in fire for effect.

Btry A operator	29—FIRING FOR EFFECT—OVER
Forward observer's operator	29—FIRING FOR EFFECT—OVER
F1 base set operator	SPLASH—OVER
Forward observer's operator	SPLASH—OVER
Btry A operator	29—ROUNDS COMPLETE—OVER
Forward observer's operator	29—ROUNDS COMPLETE—WAIT—END OF MISSION—ESTIMATE 20 CASUALTIES—OVER

d. *Relay Procedure.* When direct radio contact between the forward observer and the fire direction center cannot be established because of distance, terrain, or other limiting factors and automatic retransmission is not feasible, the following voice relay procedure will be used. This relay may be accomplished by any station in the fire direction net (F1, F2, F3) in which the forward observer is operating. For purposes of this illustration the liaison officer's station is used as the relay station.

Forward observer's operator	PERRY KILLER 76—THIS IS PERRY KILLER 64—FIRE MISSION—OVER
Liaison officer's operator	PERRY KILLER 18—THIS IS PERRY KILLER 76—FIRE MISSION FROM PERRY KILLER 64—OVER
F1 base set operator	PERRY KILLER 76—THIS IS PERRY KILLER 18—SEND YOUR MISSION—OVER

The forward observer, unable to hear the fire direction center, must be told that the FDC is ready to accept his fire request.

Liaison officer's operator	64—SEND YOUR MISSION—OVER
Forward observer's operator	FROM REGISTRATION POINT 1—AZIMUTH 3140—OVER
Liaison officer's operator	FROM REGISTRATION POINT 1—AZIMUTH 3140—OVER

F1 base set operator

FROM REGISTRATION POINT 1—AZIMUTH 3140—
OVER

At this point the relaying station operator must again tell the forward observer to continue; this is done, using the shortest transmission possible.

Liaison officer's operator	64—OVER
Forward observer's operator	RIGHT 600—ADD 1000—OVER
Liaison officer's operator	RIGHT 600—ADD 1000—OVER
F1 base set operator	RIGHT 600—ADD 1000—OVER
Liaison officer's operator	64—OVER
Forward observer's operator	INFANTRY PLATOON IN OPEN—FUZE VT—WILL ADJUST—OVER
Liaison officer's operator	INFANTRY PLATOON IN OPEN—FUZE VT—WILL ADJUST—OVER
F1 base set operator	INFANTRY PLATOON IN OPEN—FUZE VT—WILL ADJUST—WAIT—BATTERY—4 VOLLEYS—CON- CENTRATION BRAVO JULIETT 388—OVER
Liaison officer's operator	BATTERY—4 VOLLEYS—CONCENTRATION BRAVO JULIETT 388—OVER
Forward observer's operator	BATTERY—4 VOLLEYS—CONCENTRATION BRAVO JULIETT 388—OVER

At this point the battalion fire direction center alerts the battery that is to fire; therefore, to preclude the possibility of the fire direction center and the forward observer making transmissions at the same time, the relaying station operator informs the fire direction center when the forward observer has read back the message to observer.

Liaison officer's operator 18—OVER

After the battery that is to fire this mission has been alerted, firing data is sent on the fire direction net of the alerted battery, and the adjustment begins. When the battery fires the first round, it informs the relaying station in a manner exactly the same as in a normal mission.

Btry A operator	29—ON THE WAY—OVER
Liaison officer's operator	29—ON THE WAY—OVER
Forward observer's operator	29—ON THE WAY—WAIT—

The adjustment continues until the forward observer makes the request which allows the battery to go into fire for effect.

Btry A operator	29—FIRING FOR EFFECT—OVER
Liaison officer's operator	29—FIRING FOR EFFECT—OVER
Forward observer's operator	29—FIRING FOR EFFECT—OVER
Btry A operator	29—ROUNDS COMPLETE—OVER
Liaison officer's operator	29—ROUNDS COMPLETE—OVER
Forward observer's operator	29—ROUNDS COMPLETE—WAIT—END OF MIS- SION—ESTIMATE 30 CASUALTIES—OTHERS DIS- PERSED—OVER
Liaison officer's operator	END OF MISSION—ESTIMATE 30 CASUALTIES— OTHERS DISPERSED—OVER
F1 base set operator	END OF MISSION—ESTIMATE 30 CASUALTIES— OTHERS DISPERSED—CONCENTRATION BRAVO JULIETT 388—OVER
Btry A operator	END OF MISSION—CONCENTRATION BRAVO JULIETT 388—OUT
Liaison officer's operator	64—OUT

This last transmission by the relaying station is necessary to inform the forward observer that no further transmissions are expected or required in this mission.

CHAPTER 10

RADIO/WIRE INTEGRATION PROCEDURE

106. General

Most artillery headquarters are authorized radio/wire integration equipment (AN/GSA-7). This equipment can be connected into a switchboard SB-22 to provide integration of communication between FM radio nets and tactical wire systems.

107. Use

a. The use of the radio/wire integration system should be limited to instances in which communication cannot be established in the normal manner over either FM radio or wire circuits.

b. The switchboard operator is the key to this system, and he must be thoroughly trained. He must have a complete list of radio call words and suffix numbers and telephone directory names and numbers if this system is to operate satisfactorily.

c. The radio/wire integration system may be used—

- (1) To provide voice communication between mobile combat elements and elements in the rear area.
- (2) To provide a unit with temporary telephone service until trunk circuits can be installed.
- (3) To connect two switchboards and to span a break in a wire line between units.

108. Procedure

a. Normal radiotelephone procedure will be used when any part of the transmission is sent over the radio portion of the system. Normal telephone or switchboard procedure will be used between the switchboard operator and the telephone user before the wire and radio circuits are interconnected and after they are disconnected. Radio call words and telephone directory names are listed in the SOI-SSI.

b. In the following example, the call originates at a telephone.

- (1) The calling party (KENNEL 2) asks the switchboard operator (KENNEL OPER-

ATOR) for the battalion commander (KENNEL 6).

Calling party KENNEL 6

- (2) The switchboard operator will repeat the telephone directory name and number exactly as it was given to him by the calling party.

Switchboard KENNEL 6
operator

Note. At this time the switchboard operator will try to place this call over wire. For this example, we will assume that the called party does not answer.

- (3) The switchboard operator must now notify the calling party that the called party does not answer.

Switchboard THIS IS THE KENNEL
operator OPERATOR—KEN-
NEL 6 DOES NOT
ANSWER

- (4) The calling party decides that he will try to communicate with the called party using the radio/wire integration system. He will then ask the switchboard operator for the radio/wire integration station. Figure 8 illustrates the utilization of radio/wire integration facilities to connect the telephone of the division artillery commander and the radio in the battalion commander's vehicle.

Calling party KENNEL RADIO
WIRE/INTEGRA-
TION STATION

- (5) Before the switchboard operator connects the calling party with the radio/wire integration station, the following information will be given:

Switchboard KENNEL RADIO/
operator WIRE INTEGRA-

TION STATION—
USE YOUR RADIO
CALL WORD AND
SUFFIX NUMBER
AND STRICT RADIO-
TELEPHONE PROCE-
DURE—WHEN YOU
HEAR THE RUSH-
ING SOUND YOU
ARE ON THE AIR

Note. It may be necessary for the switchboard operator to give the calling party the radio call words and suffix numbers.

- (6) When the switchboard operator plugs the calling party into the line pack of the radio set control AN/GSA-7, a rushing sound will be heard. When the calling party hears the rushing sound, he can make his initial call.

Calling party LUCID BEACON 11—
THIS IS LUCID
BEACON 14—OVER

- (7) The conversation between LUCID BEACON 11 and LUCID BEACON 14 will be

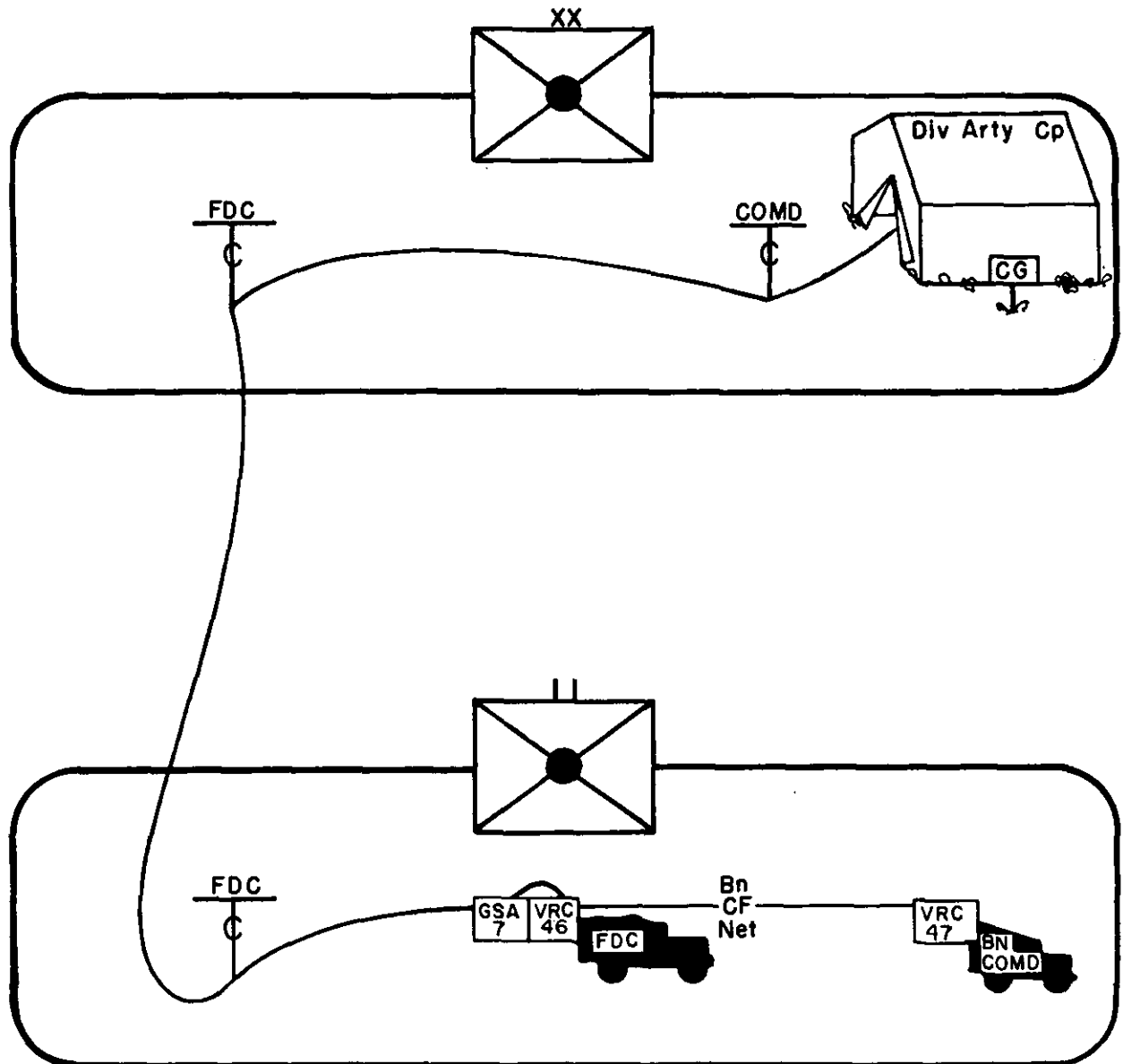


Figure 8. Type utilization of radio/wire integration system.

made using normal radiotelephone procedure. When the conversation has been completed, both stations will ring off.

- (8) When the station(s) ring off, the switchboard operator will come back on the circuit to see if either station wishes to talk to anyone else.

Switchboard THIS IS LUCID BEA-
operator CON 28—OVER

- (9) If neither station answers, the switchboard operator can then break down the call. If one of the stations answers the call, the switchboard operator can then disconnect the party not concerned.

c. The following is an example of a call originating at a radio:

- (1) The calling party (LUCID BEACON 11) wishes to talk with the division artillery S3 (LUCID BEACON 15). Using the 1600-cycle ring switch on the RT-67 or the radio frequency oscillator 0-574 ()/GRA with the RT-524, the calling party sends out a signal not exceeding 2 seconds. It is possible that more than one switchboard could have a radio set control AN/GSA-7 on this same frequency and several switchboards would have drops to fall; in this event, the calling party would wait approximately 5 seconds and then make the initial call to the control station (switchboard) with which he wishes to talk.

Calling party LUCID BEACON 28—
THIS IS LUCID
BEACON 11—OVER

- (2) When the switchboard operator (LUCID BEACON 28) hears this call, he answers. All other switchboard operators break down the call.

Switchboard LUCID BEACON 11—
operator THIS IS LUCID
BEACON 28—OVER

- (3) When the calling party hears this transmission, he will then ask the switchboard operator to connect him to the party with whom he wishes to speak.

Calling party THIS IS LUCID BEA-
CON 11—GIVE ME
LUCID BEACON 15—
OVER

- (4) To inform the calling party that he has received the call and will comply, the switchboard operator transmits as follows:

Switchboard THIS IS LUCID BEA-
operator CON 28—WILCO—
WAIT (OUT)—

- (5) The switchboard operator, without interconnecting the radio and telephone circuits, calls the desired party by telephone, using his telephone directory name and number. He tells the called party that he has a radio call for him.

Switchboard KENNEL 3—THIS IS
operator THE KENNEL
OPERATOR—I HAVE
A CALL FOR YOU
OVER RADIO FROM
KENNEL 6—USE
YOUR RADIO CALL
WORD AND SUFFIX
NUMBER AND
STRICT RADIOTELE-
PHONE PROCE-
DURE—WHEN YOU
HEAR THE RUSH-
ING SOUND, YOU
ARE ON THE AIR —
MAKE THE INITIAL
CALL

- (6) When the called party hears the rushing sound, he then makes his initial call.

Called party LUCID BEACON 11—
THIS IS LUCID
BEACON 15—OVER

- (7) The calling party transmits his message and the conversation ends. Both parties ring off if possible.

- (8) When the station(s) ring off, the switchboard operator will come back on the air to see if either station wishes to talk to anyone else.

Switchboard THIS IS LUCID
operator BEACON 28—OVER

- (9) If neither station answers, the switchboard operator can then break down the call. If one of the stations answers the call, the switchboard operator can then disconnect the party not concerned.

CHAPTER 11

TELEPHONE AND SWITCHBOARD PROCEDURE

109. General

In order to effectively utilize the wire communication available to a unit, all persons who use this means of communication must be familiar with the proper procedure and techniques involved in its operation, including the telephone directory, field telephone, and switchboard.

110. Telephone Directory

The purpose of the military telephone directory is to simplify and expedite communication in a field telephone system. The telephone directory consists of two parts, directory names and directory numbers, both of which are found in the SOI-SSI. Telephone directory names are assigned to organizations normally equipped with switchboards. The names are changed when there is a possibility of confusion with directory names of other divisions or units or for security reasons. Command and staff officers and installations *not* normally equipped with a switchboard are assigned a telephone directory number. The military telephone directory is prepared as part of the SOI-SSI by the signal officer of the division or of a higher echelon.

a. Directory Names. Directory names of all major units in a division begin with the same letter. Separate battalions and batteries are assigned separate directory names. Units at battery level use the directory name of their battalion plus the suffix ALFA, BRAVO, or CHARLIE. A separate battery may be assigned a directory name or may be assigned a telephone number as a suffix to the directory name of its parent unit. Directory names should not be used alone but always in conjunction with the appropriate directory number or echelon of the installation being called.

b. Directory Numbers. Telephone directory numbers, once assigned, are not changed. To prevent confusion, the same number is prescribed for similar officers and offices throughout the command. A complete list is published in the unit SSI. Telephones not assigned a directory number are identi-

fied by an appropriate abbreviation or word description of the installation.

111. Telephone Operation

The telephone is used to provide personal contact between two or more individuals. Conversations should be as short as possible. Written messages should not be transmitted by telephone unless it is unavoidable and/or speed is essential.

a. Classification of Calls. There are two types of telephone calls, *urgent* and *routine*.

- (1) An urgent call is one that is given precedence over existing circuits to the extent that it warrants interruption of a connection already made. However, one urgent call will not normally interrupt another urgent call already in progress. Urgent calls are reserved for reports containing information which may materially affect plans or change a course of action such as initial contact with the enemy, amplifying or subsequent enemy contact reports, and artillery fire missions. Normally, only personnel designated by the commander are authorized to place urgent calls; however, in an emergency, anyone may place an urgent call.
- (2) Routine calls have no precedence but are handled in the order received by the operator. Routine calls constitute the bulk of the traffic handled over a military wire system. These calls may contain routine information, which, although important, does not require special handling. All personnel using the military telephone system are authorized to place routine calls.

b. Placing Calls. In placing a telephone call, the calling party must be familiar with, or refer to, the telephone directory. Switchboard operators should not be required to look up telephone directory names and numbers for the calling party.

- (1) In placing an urgent call, the calling party

initiates the call, using the operating phrase URGENT CALL FOR. He then announces the called party's telephone directory name and number followed by the operating phrase THIS IS and his official designation. For example, an urgent call from the liaison officer, 1st Battalion, 3d Artillery, to the battalion commander would be announced to the switchboard operator as URGENT CALL FOR KENNEL 6. This is KENNEL 9.

- (2) In placing a routine call, the calling party announces to the switchboard operator the directory name and number of the called party. For example, a routine call from the commanding officer of Battery A, 1st Battalion, 3d Artillery, to the battalion S3 would be announced to the switchboard operator as KENNEL 3. A call for an unlisted telephone, such as the battalion OP, 1st Battalion, 3d Artillery, would be announced to the switchboard operator as KENNEL OP.

c. Response. In response to telephone calls, the answering party should state the directory name and number of the telephone and his official designation; for example KENNEL 6, COMMANDING OFFICER SPEAKING; KENNEL 3, S3 SPEAKING; or KENNEL 3, OPERATOR SPEAKING.

d. Conversations. The procedure in person-to-person conversations, other than that used in placing and answering the call, follows no particular pattern of operating words and phrases. The parties connected use normal conversational language. To obtain maximum benefit from the military telephone system, person-to-person conversations should be well thought out before the call is placed. The use of prepared notes is recommended.

e. Oral Messages. The transmission of an oral message differs from person-to-person conversation in that the persons transmitting and receiving the message are usually neither the originator nor addressee. An oral message normally is not written on the prescribed message form or submitted to the message center for transmission, but, since a third person is involved, operating words and phrases are used. For example—

- (1) After the calling and called parties have been connected, the phrase MESSAGE FOLLOWS is used by the transmitting operator to alert the receiving operator that a message which requires recording is about to follow.

- (2) Procedure words and phrases, such as READ BACK, I READ BACK, THAT IS CORRECT, WRONG, SAY AGAIN, I SAY AGAIN, ROGER, OVER, OUT, etc., are used by both parties when applicable.
- (3) Assume that the S3, 1st Battalion, 3d Artillery, tells his operations sergeant to call the commanding officer of Battery A and give him the following information: HAVE SURVEY DETAIL CONSISTING OF FOUR MEN AND ONE VEHICLE REPORT TO POINT XRAY at 1320 SIERRA. The operations sergeant, using the S3 phone, rings the switchboard operator and says KENNEL ALFA 6.
- (4) The switchboard operator puts the call through, and the battery commander's operator answers KENNEL ALFA 6, OPERATOR SPEAKING.
- (5) The operations sergeant then transmits THIS IS KENNEL 3, OPERATIONS SERGEANT SPEAKING, MESSAGE FOLLOWS, READ BACK, HAVE SURVEY DETAIL CONSISTING OF FOUR MEN AND ONE VEHICLE REPORT TO POINT XRAY AT 1320 SIERRA, OVER.
- (6) The receiving operator at KENNEL ALFA 6 transmits I READ BACK, HAVE SURVEY DETAIL CONSISTING OF FOUR MEN AND ONE VEHICLE REPORT TO POINT XRAY AT 1320 SIERRA, OVER.
- (7) The message is read back correctly, and the operations sergeant transmits THAT IS CORRECT, OUT.

112. Switchboard Operating Phrases

The switching central provides the wire system with flexibility and is the heart of the wire system. It is important that all switchboard operators and communication personnel use a standardized procedure and method in operating the switchboard. A complete list of words and phrases to be used by operators, for all types of operations, are published in ACP 134(A). A partial list of the more commonly used operating phrases are given in *a* through *m* below.

a. KENNEL OPERATOR—In answering an incoming call, the switchboard operator announces his telephone directory name followed by the word OPERATOR.

b. *KENNEL 6*—On receiving the number from the calling party, the switchboard operator repeats the telephone directory name and number exactly as it was given him by the calling party.

c. *WHAT NUMBER PLEASE*—Phrase used by the operator to request repetition of a number which he has not understood.

d. *THE LINE IS BUSY*—Phrase used by the operator to report that a local telephone, for which he has received a call, is already in use or that all trunks to a desired central are in use.

e. *KENNEL 6, URGENT CALL*—On receiving an urgent call, the switchboard operator repeats the telephone directory name and number followed by the phrase *URGENT CALL*.

f. *ACORN DOES NOT ANSWER*—Phrase used by the *KENNEL* operator to inform the calling party that the called telephone central (*ACORN*) does not answer.

g. *I WILL RING AGAIN*—Phrase used by the operator when, in supervising a connection, he is informed that the called party did not answer.

h. *WHAT IS YOUR NUMBER PLEASE*—Phrase used by the operator if, after supervising a connection, he is given a new number to call by one of the parties but is unable to identify the calling party.

i. *HAVE YOU FINISHED*—Phrase used by the operator in supervising a connection. He repeats the challenge once more; if no reply is heard the connection is broken.

j. *CONFERENCE CALL, KENNEL 5, KENNEL 3, KENNEL 2, I WILL CALL YOU BACK*—Phrases used by the operator to indicate that he has understood correctly the numbers given to him by the calling party and that, after completing the calls, he will call the originator back as requested.

k. *CONFERENCE CALL, KENNEL 5, KENNEL 3, KENNEL 2, ONE MOMENT PLEASE*—Phrases used by the operator to indicate that he has understood correctly the number given him and to hold the calling party on the line while the connection is being completed.

l. *CONFERENCE CALL FOR YOU, ONE MOMENT PLEASE*—Phrases used by the operator to inform the called party that he has a conference call for him and that there will be a delay in completing the connection.

m. *YOUR CONFERENCE CALL, GO AHEAD, PLEASE*—Phrase used by the operator to inform the calling party that the connection is complete and conversation may begin.

CHAPTER 12

TRAFFIC DIAGRAM AND LINE ROUTE MAP

113. Definition of A Traffic Diagram

A traffic diagram is an illustration showing the telephone and teletypewriter circuits existing between switching centrals of a wire system. Long local circuits may also be shown.

a. Preparation. A traffic diagram is prepared at each switching central by the wire chief or chief operator assisted by the operator on duty. The operator will keep the traffic diagram current during his tour of duty. The traffic diagram may be drawn on the yellow strip provided on the switchboard. Circuits will be tested and determined to be in operating condition before they are recorded on the traffic diagram.

b. Purpose. The traffic diagram is used by the switchboard operator to route calls by the most direct route. A traffic diagram also shows alternate routes if direct routes are busy or out of service.

c. Security. Local security measures will determine the extent of information that will be placed on traffic diagrams.

114. Constructing A Traffic Diagram

Switching centrals are indicated by the appropriate directory name enclosed within a large circle on the traffic diagram (fig. 9). Unit designations may be shown by symbols when security is not jeopardized. Local telephones are represented by a small circle with an identifying abbreviated designation.

a. Trunk circuits are indicated by single lines drawn between the switching centrals.

b. Local circuits are represented by single lines drawn between the appropriate symbols; e.g., a unit directory name enclosed within a large circle represents a switching central, and a small circle identified by the abbreviated designation represents a telephone.

c. The number of channels available is indicated by a number placed along the line between switching centrals. Simplex circuits and phantom circuits are included as channels only when the switchboard

operator can control these circuits; e.g., when the phantom or simplex circuit is terminated through a repeating coil and a line pack.

d. When possible, systems connecting higher, lower, and adjacent units should be included in the diagram.

e. Marginal information is not included in a traffic diagram. However, if a copy of the traffic diagram is to be forwarded to higher headquarters, the copy forwarded should include the—

- (1) Name of the diagram.
- (2) Unit designation of the originator.
- (3) Date and time of preparation.
- (4) Authentication. (The communication officer or his authorized representative must sign the traffic diagram before it is forwarded.)

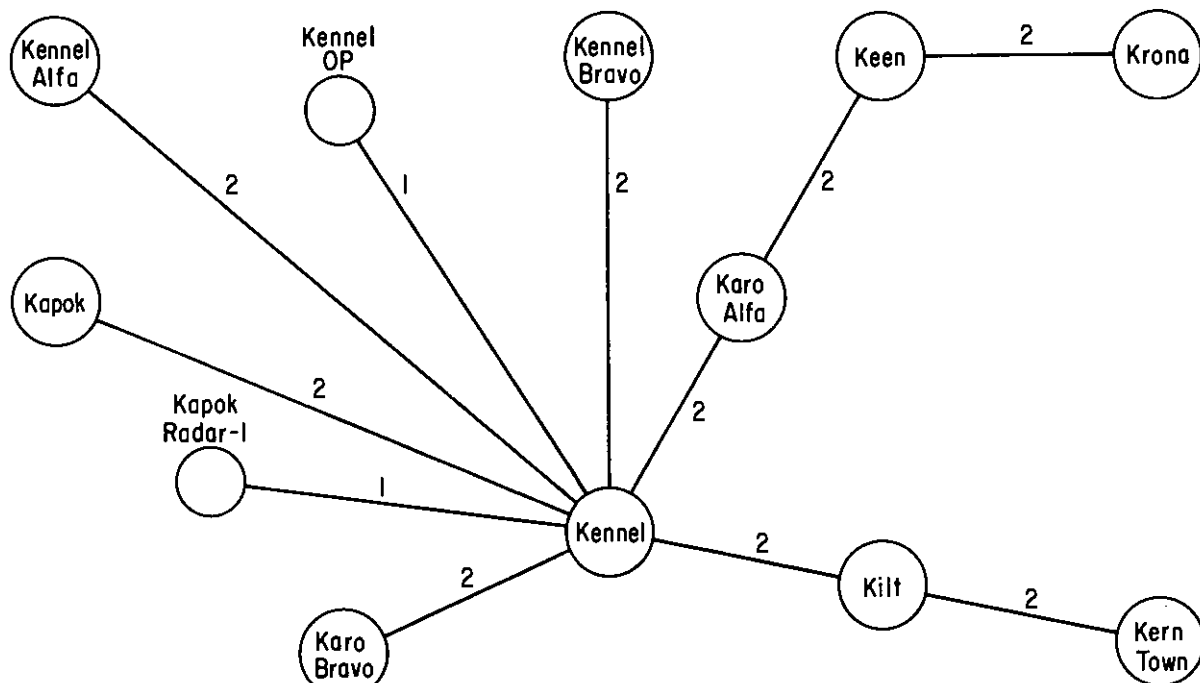
f. Figure 9 represents a traffic diagram prepared by the 1st Battalion, 3d Artillery, to be forwarded to higher headquarters.

115. Line Route Map

a. Definition. A line route map is a map, map substitute, or overlay, suitably titled, on which the actual or projected routes of wire circuits are shown. The line route map does not show the actual connection at the switching central.

b. Uses. The principal uses of the line route map are to report the physical location of wire circuits as actually installed on the ground, to direct the installation of the wire system, to aid in the maintenance of the wire system, to aid in the recovery of wire, and to turn wire circuits over to a relieving unit.

c. Preparation. The battalion communication officer is responsible for the construction, use, and safeguarding of the battalion line route map. The line route map is prepared in duplicate. It is normally prepared by the wire chief and checked by the communication chief. When directed, the firing battery line route map is prepared by the battery wire team chief.



Telephone Traffic Diagram
1st How Bn, 3d Arty
As of 191300S, Oct 59
W. Shepard
Capt, Arty, Comm Off

Figure 9. Type traffic diagram.

d. Disposition. One copy of the line route map is sent to the next higher headquarters; the other copy is posted in the vicinity of the switchboard of the originating headquarters. Battery line route maps are forwarded when directed or in accordance with local standing operating procedures (SOP).

e. Construction. The line route map should contain only those lines, symbols, and notations necessary for clarity. Each headquarters or establishment served by the wire system is shown by the authorized military symbol. Switching centrals, which are part of the wire system, will be shown by the authorized military symbol. Telephones, when shown, are represented by a small circle. Trunklines and long locals are represented by a single line drawn along the exact route over which the circuit is installed. The number of physical circuits installed along a particular route is indicated by a number placed next to the line. Simplex and phantom circuits are not shown on the line route map. Field wire circuits indicated on the line route map are laid on the

ground unless otherwise indicated. Overhead circuits (TTTTTTTT) or underground circuits (—□□□—) will be shown by their appropriate symbol. All line route maps prepared on overlay paper must include at least two orientation points taken from the map from which the overlay was made. The following information will be placed on the line route map wherever space is available:

- (1) What is it? Line route map.
- (2) Who prepared it? The designation of the unit preparing the line route map.
- (3) When was it prepared? The date and time of preparation.
- (4) In what area is it located? Title and scale of map.
- (5) Authentication? Normally authenticated by the unit communication officer signing it.

f. Security. Line route maps normally will not be taken into forward areas. Maintenance crews

will carry only the extracts which pertain to their particular mission. Such extracts will not include unit designations.

g. Typical Line Route Map. Figure 10 shows a typical line route map prepared by the 1st Battalion, 3d Artillery.

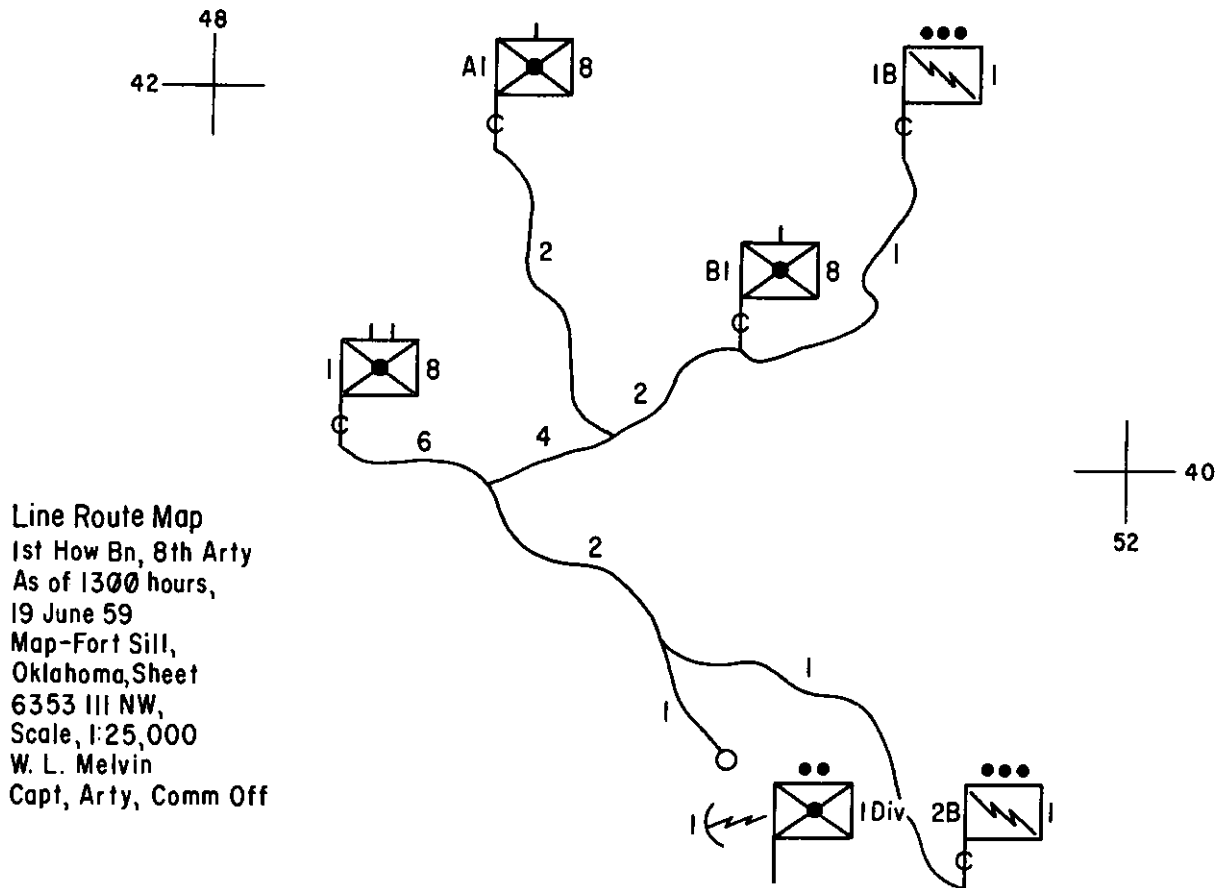


Figure 10. Line route map overlay.

CHAPTER 13

COMMUNICATION EQUIPMENT

Section I. INTRODUCTION

116. General

This chapter contains general information concerning communication equipment used in field artillery units. For detailed information pertaining to this equipment and equipment not included in this chapter, see the appropriate technical manuals of the 11-series.

117. Wire Equipment

Wire equipment consists of signal equipment

necessary to install, operate, and maintain a unit wire system, to include teletypewriter equipment.

118. Radio Equipment

Radio equipment consists of signal equipment necessary to install, operate, and maintain unit radio nets, to include radio teletypewriter equipment.

Section II. WIRE EQUIPMENT

119. General

This section contains general information concerning the characteristics of wire equipment used by artillery units. For operating instructions and detailed information pertaining to this equipment see the appropriate technical manuals of the 11-series. For detailed information concerning field wire techniques, see FM 24-20.

120. Telephone Wire WD-1/TT

Telephone wire WD-1/TT (fig. 11) consists of two twisted, individually insulated, conductors having the following characteristics:

- a. American wire gage (AWG) No. 23 (each conductor).
- b. Four tinned-copper strands and three galvanized-steel strands per conductor.
- c. Inner insulation of polyethylene and outer insulation jacket of nylon.
- d. Tensile strength of approximately 200 pounds (both conductors).
- e. Weight of 48 pounds per mile.
- f. Direct current (DC) loop resistance of 200 to 234 ohms per mile at 70° Fahrenheit (F.).
- g. Signal loss at 1 kilocycle (kc) at 68° F. of 2.5 decibels (db) per mile under wet conditions or 1.5 decibels per mile under dry conditions.

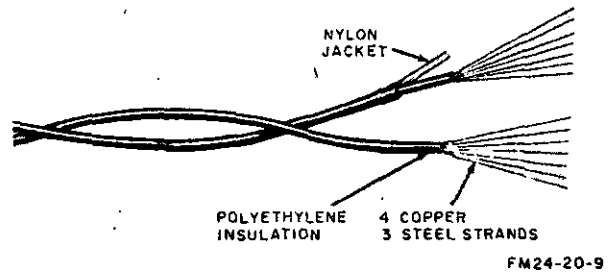


Figure 11. Telephone wire.

121. Five-Pair Cable

a. Telephone cable assembly CX-162/G consists of five pairs of rubber-insulated, color-coded, No. 19 AWG, tinned, solid-copper conductors. Cotton cord is used in the center and as a filler between pairs. A cotton yarn separator is applied over the assembled conductors, and black, vulcanized, or synthetic rubber is molded around the outside to form the cable jacket. The cable is equipped with a connector on each end.

b. Telephone cable assembly CX-162/G is furnished in 1/2-mile and 1000-, 500-, 200-, and 100-foot lengths. A 12-foot length of telephone cable assembly CX-163/G (fig. 12) has a connector at one

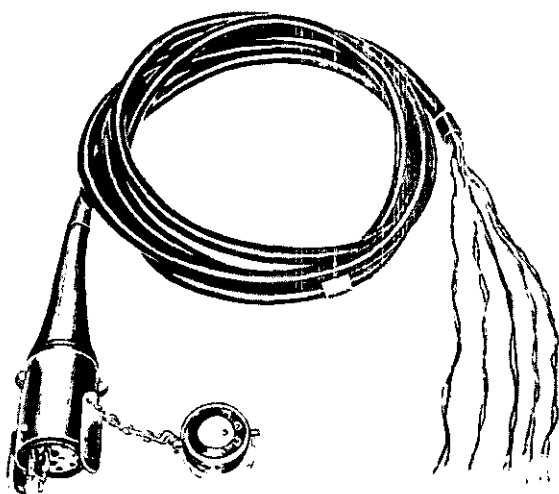


Figure 12. Telephone cable assembly CX-163/G.

end which connects to a telephone cable assembly CX-162/G at the other end; the individual cable connectors are separated to permit connection to binding posts.

c. To facilitate installation and to eliminate large numbers of field wire circuits, five-pair cable is used in congested areas where a concentration of communication circuits is required. It is particularly useful for installing circuits from a wire-head, or patching panel, to the switchboard in a command post or as a distribution cable for local circuits.

122. Spiral-Four Cable

a. *General.* Spiral-four cable consists of 4 separately insulated conductors twisted about a common axis and is normally used to provide a four-wire transmission line for a carrier communication system. It also can be used for long-distance voice-frequency circuits. Detailed information concerning cable assemblies using spiral-four cable (telephone cable WF-8/G) is contained in TM 11-381.

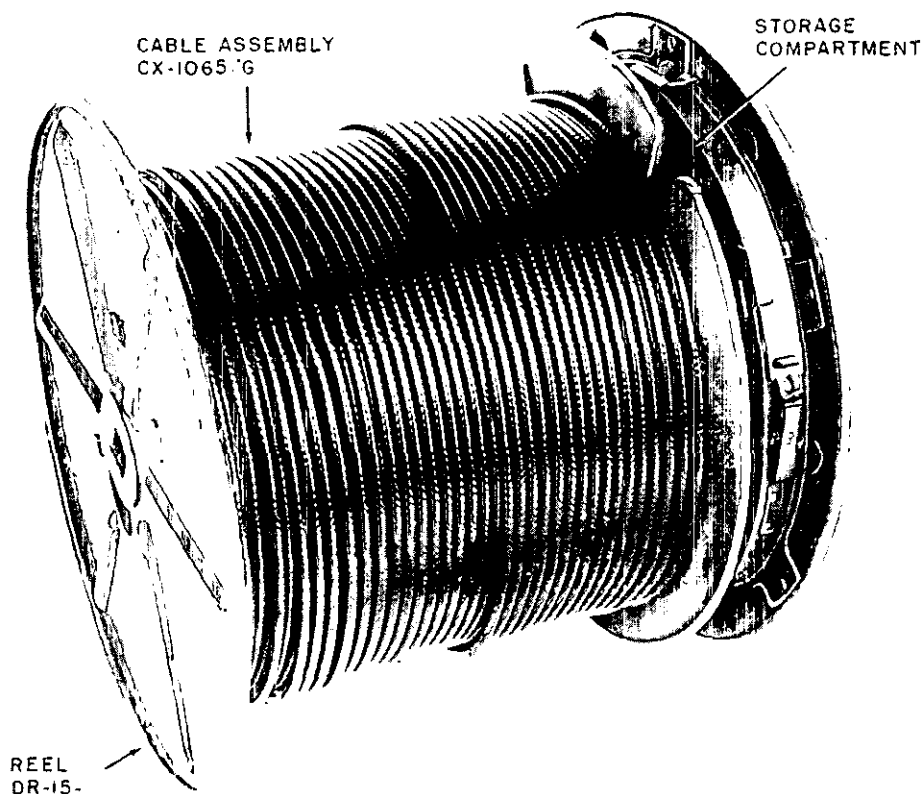


Figure 13. Telephone cable assembly CX-1065/G, wound on cable reel DR-15.

b. *Telephone Cable Assembly CX-1065/G*. Telephone cable assembly CX-1065/G consists of approximately one-fourth mile (1,280 to 1,360 feet) of spiral-four cable (telephone cable WF-8/G) fitted at each end with a universal connector. A pair of conductors connect the male contacts of the connector on one end to the female contacts of the connector on the other end. The steel braid is connected to the connector case at each end. Two or more of these assemblies are joined to form a transmission line of any required length. The cable assembly is supplied on cable reel DR-15 (fig. 13). The storage compartment on the reel holds both connectors plus about 12 feet of the inner end of the cable.

c. *Cable Assembly, Special Purpose, Electrical CX-1512/U*. Cable assembly CX-1512/U (fig. 14) is a cable stub and consists of 12 feet of spiral-four cable (telephone cable WF-8/B) fitted at one end with a universal connector. The four conductors and steel braid are separated at the other end, allowing the spiral-four cable to be connected to terminal equipment not equipped with universal connectors. The assembly weighs 2 pounds and contains a pair of 6-millihenry loading coils which

decrease the cable attenuation on the 0- to 20-kilocycle frequency range. The end caps should be kept screwed on the loading coil when it is not in use to protect the faces from moisture, dirt, and damage.

- (1) A nylon yarn braid covers the open ends of the steel braid. The steel braid termination is made at the top of the nylon braid for ease of identification.
- (2) The conductors are bared about three-fourths of an inch and tinned. The tinned ends prevent fraying of the conductor strands and provide a good electrical connection.

123. Telephone Wire Splicing Equipment

Field telephone wire splices can be made with either telephone cable splicing kit MK-356/G or tool kit TE-33.

a. *Splicing Kit, Telephone Cable MK-356/G*. Splicing kit telephone cable MK-356/G (fig. 15) is designed for rapidly splicing telephone wire WD-1/TT (standard splice). The kit consists of splicing tool TL-582/U, 4 magazines, a carrying bag, and

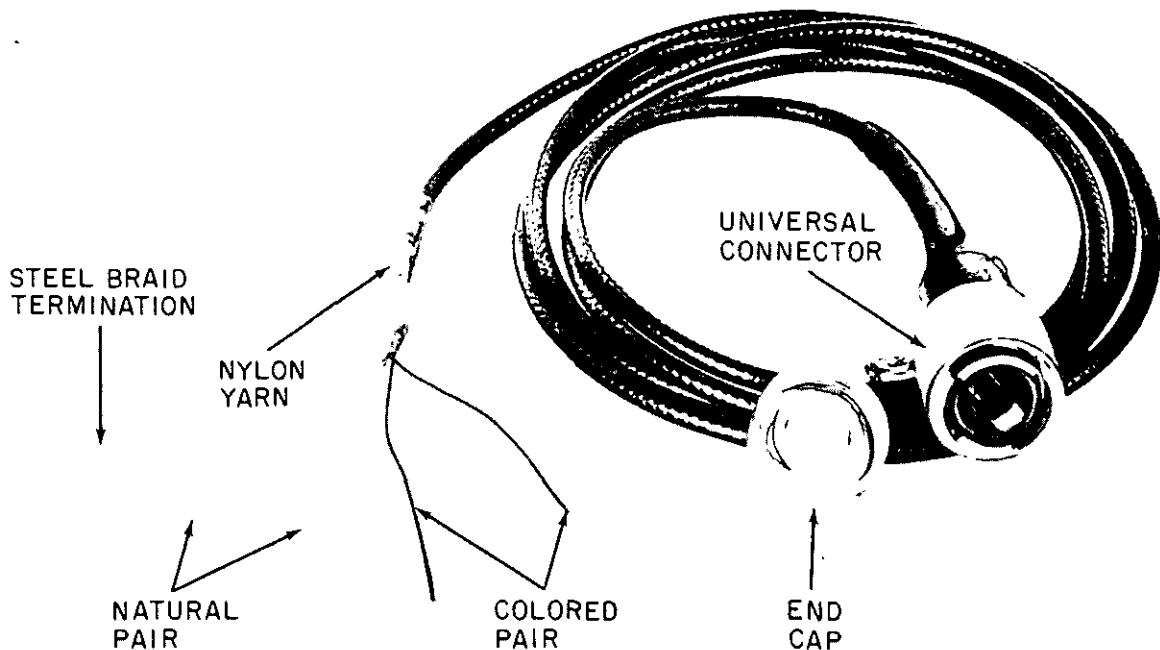


Figure 14. Telephone cable assembly CX-1512/U, special purpose, electrical.

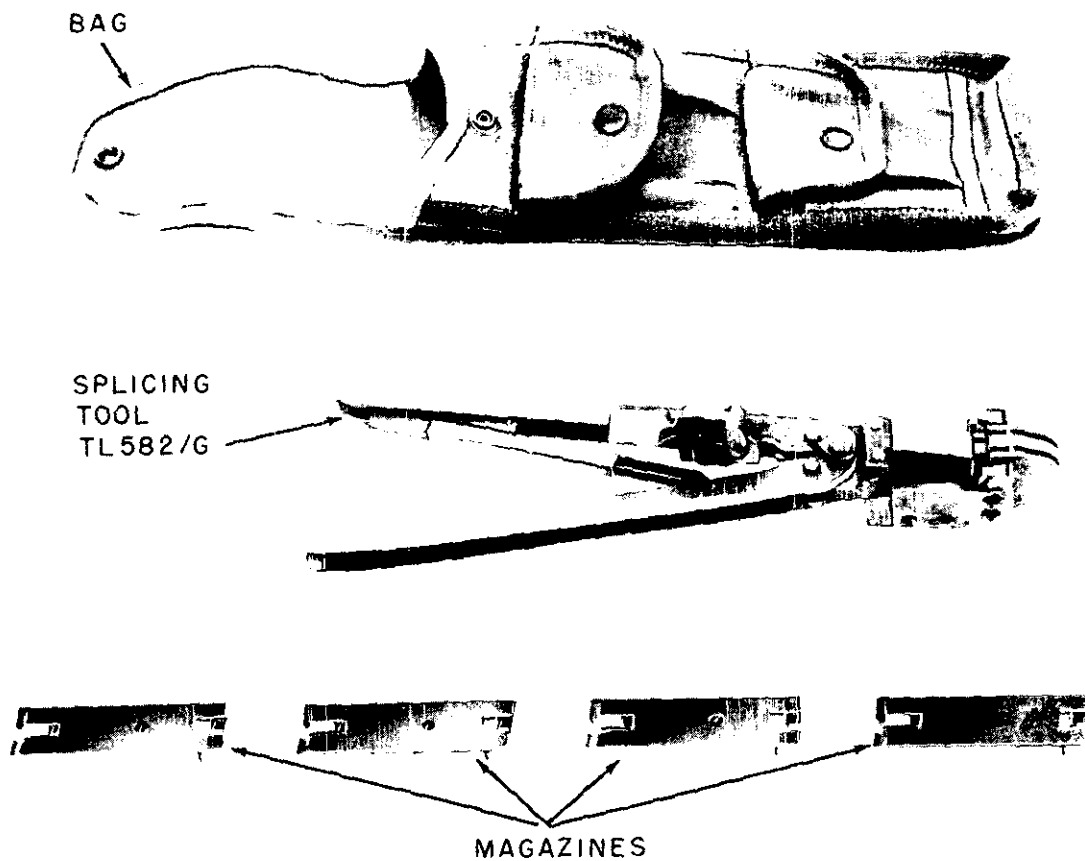


Figure 15. Telephone cable splicing kit MK-356/G.

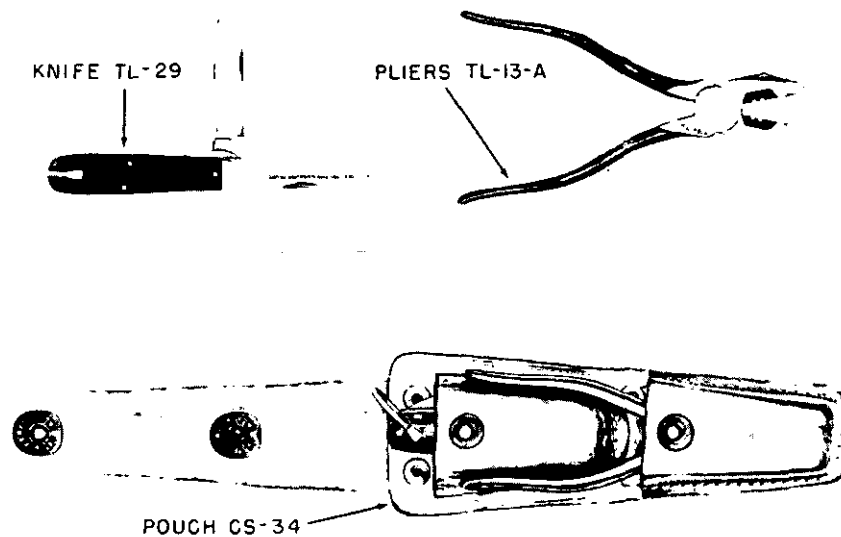


Figure 16. Tool equipment TE-33.

200 splicing connectors (sleeves). The kit is 12 inches long and weighs approximately 3½ pounds.

b. *Tool Kit TE-33.* Tool Kit TE-33 (fig. 16) is also used for making telephone cable and wire splices. It consists of a holder, carrying, lineman's pliers CS-34; pliers TL-13A, and electricians knife TL-29. Two types of insulating tape can be used in making telephone cable and wire splices—electrical tape TL-636/U (black polyethylene), used in tropical and temperate zones, and electrical insulation tape TL-600/U (white polyethylene), used in the Arctic zone and during cold weather in temperate zones. Tape TL-83 (friction) may be used for added protection of the splice. To improve the splice mechanically and electrically, a small gage, softdrawn copper wire (known as seizing wire) may be used. Seizing wire may be obtained from the copper conductors in a piece of telephone cable.

124. Telephone Cable Reels

The three types of reels (fig. 17) available for use with telephone wire are as follows:

a. Cable reel DR-5 is a metal, spool-type container used to store, transport, lay, or recover

telephone wire WD-1/TT. It will hold 2½ miles of telephone wire and can be mounted on cable reeling machine, hand, RL-31 or cable reeling machine, engine-driven, RL-207/G.

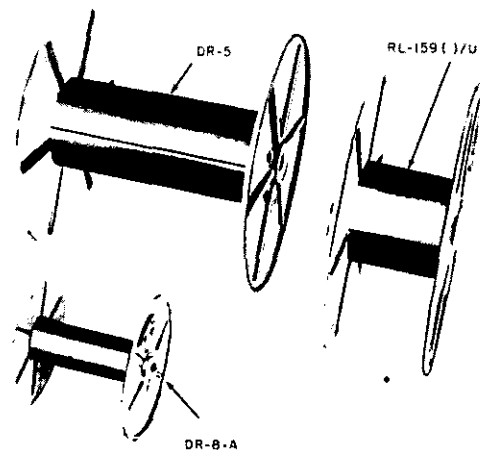


Figure 17. Reels for telephone cable.

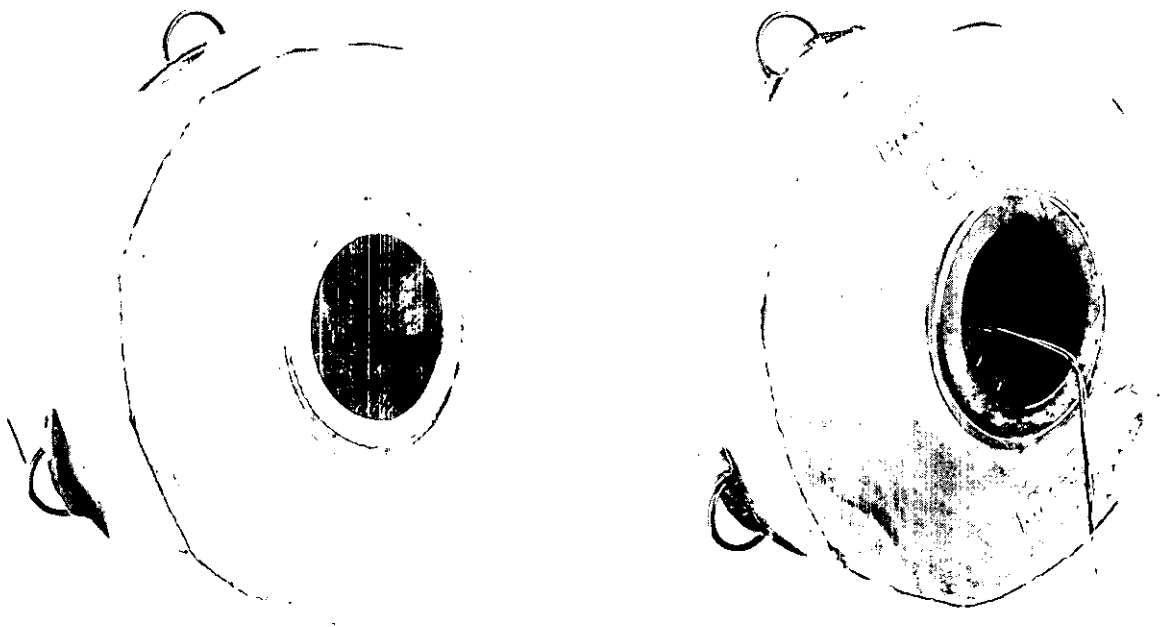


Figure 18. Wire dispenser MX-306A/G.

b. Cable reel RL-159/U is a metal, spool-type container used to store, transport, lay, or recover telephone wire WD-1/TT. The reel will hold 1 mile of wire and can be mounted on cable reeling machine, hand, RL-31; cable reeling machine, hand, RL-27, cable reeling machine, motor driven, RL-172, or cable reeling machine, engine-driven, RL-207/G.

c. Cable reel DR-8 is a metal container used to lay or recover telephone wire. The reel will hold one-fourth mile of telephone wire WD-1/TT and can be mounted on cable reeling machine, hand, RL-39.

125. Wire Dispenser MX-306A/G

a. Wire dispenser MX-306A/G (fig. 18) is a cylindrical canvas and tape container that holds approximately one-half mile of telephone wire WD-1/TT. The telephone wire of two or more dispensers may be prespliced in tandem when it is necessary to lay more than one-half mile of wire without stopping to make a splice.

b. The wire dispenser MX-306A/G has many useful features:

- (1) It is portable.

- (2) It will pay out wire at high speeds from land and amphibious vehicles or from fixed- and rotary-wing aircraft.
- (3) It will function at speeds up to 100 miles per hour.
- (4) It lays the wire flat on the surface of the ground without spirals or kinks.

c. No special mounting devices are necessary if a single dispenser is used to lay the wire. Wire dispenser cases CY-1064/ATC, which holds four dispensers; CY-1064A/ATC, which holds five dispensers, and CY-196/ATC, which holds six dispensers, are available for use in laying telephone wire from aircraft. For more detailed information, refer to TM 11-2240.

126. Cable Reeling Machine, Hand, RL-27

Cable reeling machine, hand, RL-27 (fig. 19), is a simple axle designed for laying and recovering telephone wire. The axle is a machined-steel bar (2½ feet long) with two knurled handles, one of which can be removed to mount cable reel RL-159/U on the axle. It is equipped with roller bearings and a removable crank for rewinding the wire. The reeling machine can be carried by two men, or it can be placed on some improvised mounting.



Figure 19. Cable reeling machine, hand RL-27.

127. Cable Reeling Machine, Hand, RL-31

a. Cable reeling machine, Hand, RL-31 (fig. 20), is a lightweight, portable, folding A-frame of steel tubing used for laying and recovering telephone wire and cable assemblies. This reeling machine is equipped with—

- (1) A brake unit for controlling the speed of the reels as the wire or cable is payed out.
- (2) A crank for winding the wire or cable on the reels.

- (3) A carrying strap for carrying the reeling machine litter style.
- (4) A divided axle for use when two reels are mounted on the reeling machine. This axle allows either reel to operate independently of the other. (When the divided axle is used, two cranks and two brakes are necessary for operation. This equipment is issued with the reel unit).

b. The reeling machine has a capacity of one cable reel DR-5, one cable reel DR-15, or two cable reels RL-159/U. Cable reels DR-15 are used with cable assemblies.

128. Cable Reeling Machine, Motor-Driven, RL-172/G

Cable reeling machine, motor-driven, RL-172/G (fig. 21), which weighs approximately 100 pounds, is used to lay and recover telephone field wire. The reeling machine is normally mounted vertically on the tail gate of a truck, but may also be mounted

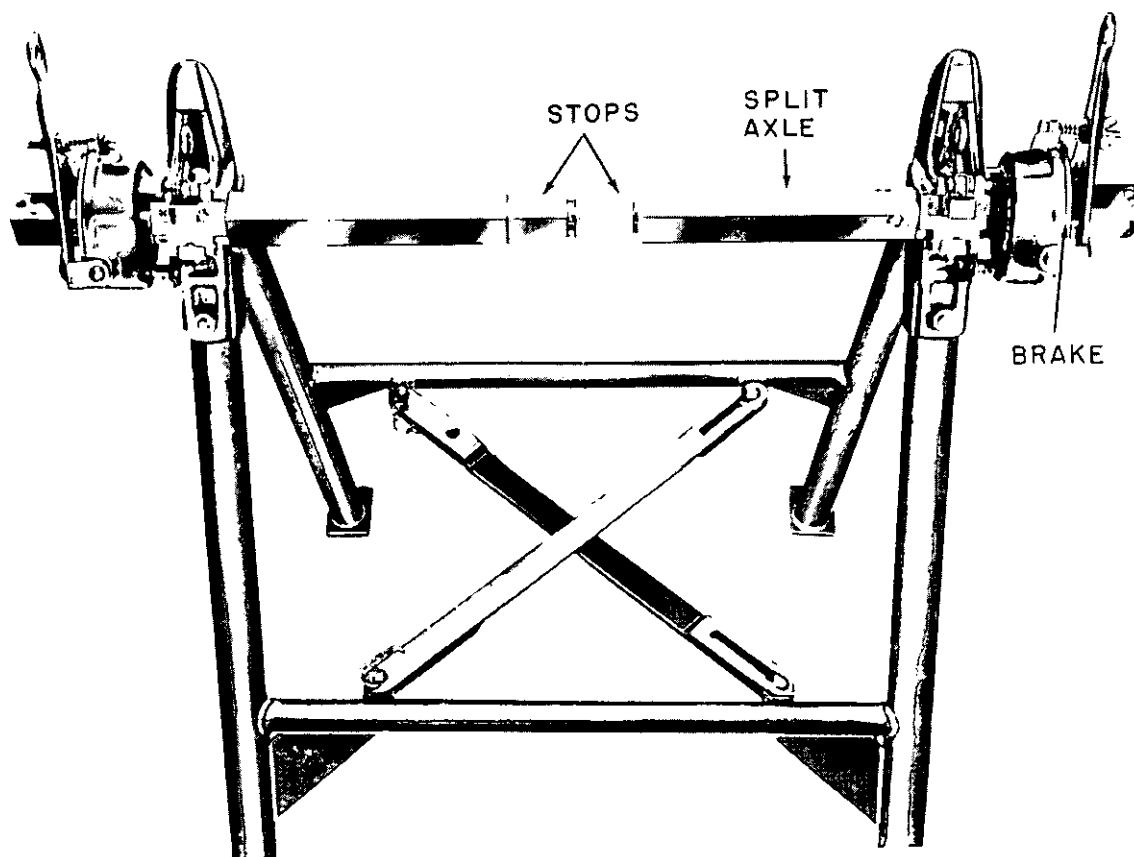


Figure 20. Cable reeling machine, hand RL-31.

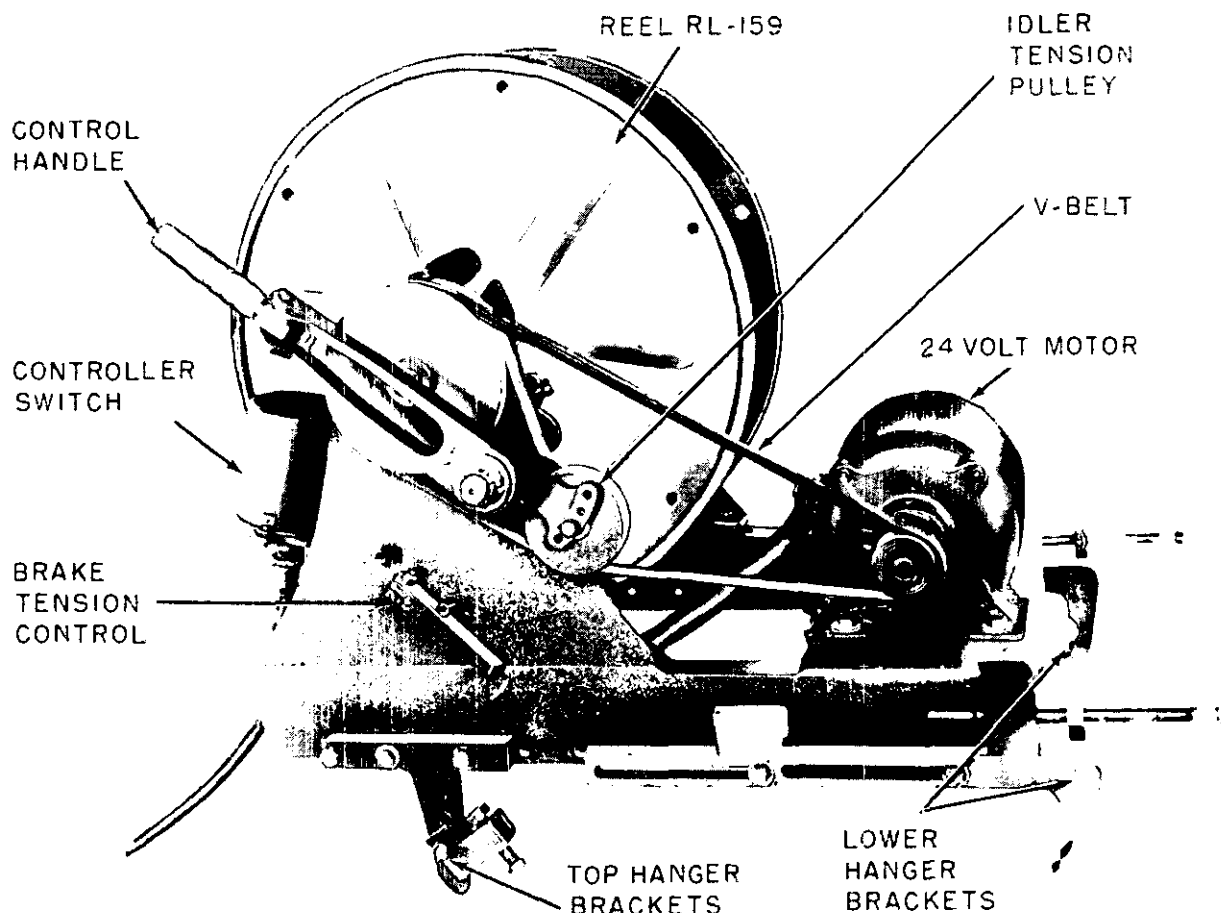


Figure 21. Cable reeling machine, motor-driven RL-172/G.

and operated from a horizontal position on the bed of a truck.

a. The reel is driven by a 24-volt, DC motor. Power for the motor is furnished by the battery of the vehicle in which the reel is mounted. A vehicle on which the RL-172/G is to be operated should be equipped with a 100-ampere alternator instead of the DC generator, and it must be equipped with a receptacle, slave, 24-volt, waterproof, with cable (FSN 2590-693-4179).

b. A handcrank is provided for manual operation.

c. The reeling machine is designed for one-man operation and is equipped with controls for starting, stopping, and reversing the movement of one cable reel RL-159/U.

d. The telephone wire can be payed out up to a maximum speed of 25 miles per hour and can be recovered at speeds of 7 to 17 miles per hour. The

speed of the reel can be controlled, and the payout speed is determined by the speed at which the vehicle can be safely operated.

e. For complete details on the operation, organizational maintenance, and repair parts for the unit, refer to TM's 11-3895-207-10, -20, and -20P.

129. Cable Reeling Machine, Engine-Driven, RL-207/G

a. Cable reeling machine, engine-driven, RL-207/G is a transportable, wire- and cable-laying and recovery machine driven by a gasoline engine. This reel unit which weighs approximately 490 pounds, is normally mounted in a $\frac{3}{4}$ -ton or larger vehicle, but it can be operated on the ground. The reeling machine has a capacity of two cable reels DR-5, two cable reels DR-15, or four cable reels RL-159/U.

b. The wire or cable can be payed out or recovered from any reel separately or from all reels simultaneously. Telephone wire WD-1/TT can be payed out at a maximum speed of 25 miles per hour and may be recovered up to a speed of 5 miles per hour. The payout speed is determined by the speed at which the vehicle can be safely operated.

c. For complete details on the operation, organizational maintenance, and repair parts for the unit, refer to TM's 11-3895-209-12 and -20P.

130. Wire Pike MC-123

Wire pike MC-123 consists of a two-section pole, joined by metal fittings. The top section terminates in a hook, fitted with a roller which is used by wiremen to lay or recover telephone wire. As the wire is payed out, the hook is used to guide the wire along the side of the road. For wire recovery, it provides an even feed and guides the wire to the reeling machine.

131. Climbers LC-240/U

a. *General.* Climbers LC-240/U (fig. 22) are adjustable, lightweight, metal climbers. The length of the climbers can be adjusted from 14 $\frac{3}{4}$ inches to 19 $\frac{1}{2}$ inches to conform to different leg length. Climbers LC 240/U consist of two leg irons, 2-inch and 3-inch interchangeable gaffs, leather fastening straps, and climber pads. The 2-inch gaffs are used for climbing poles or trees with thin bark, and the 3-inch gaffs are used for climbing trees with thick bark.

b. *Adjustment.* To adjust the leg irons, the two leg-iron screws are removed, the slide assembly is moved on the leg iron to the desired length, and the leg-iron screws are inserted in the nearest screw holes, and secured.

c. *Gaff Removal.* To remove the gaffs, the two gaff retaining screws are released, and the gaff is moved downward toward the stirrup and lifted out

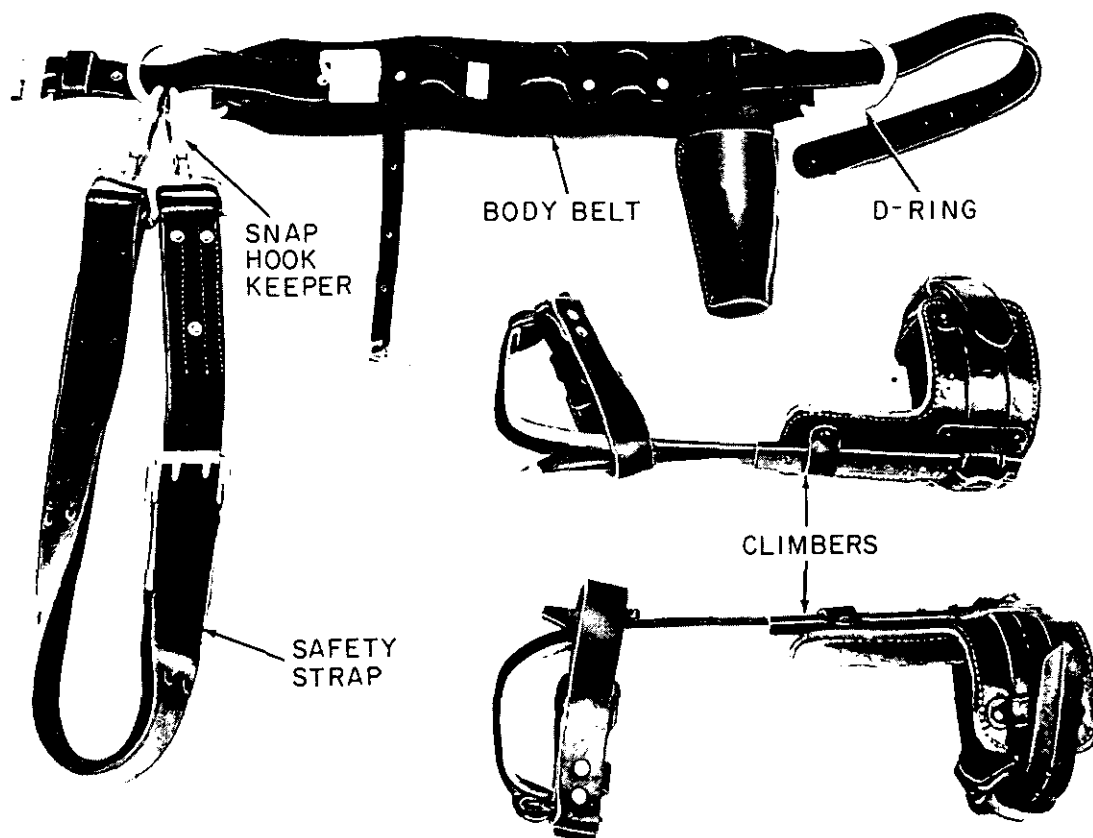


Figure 22. Climbers LC-240/U.

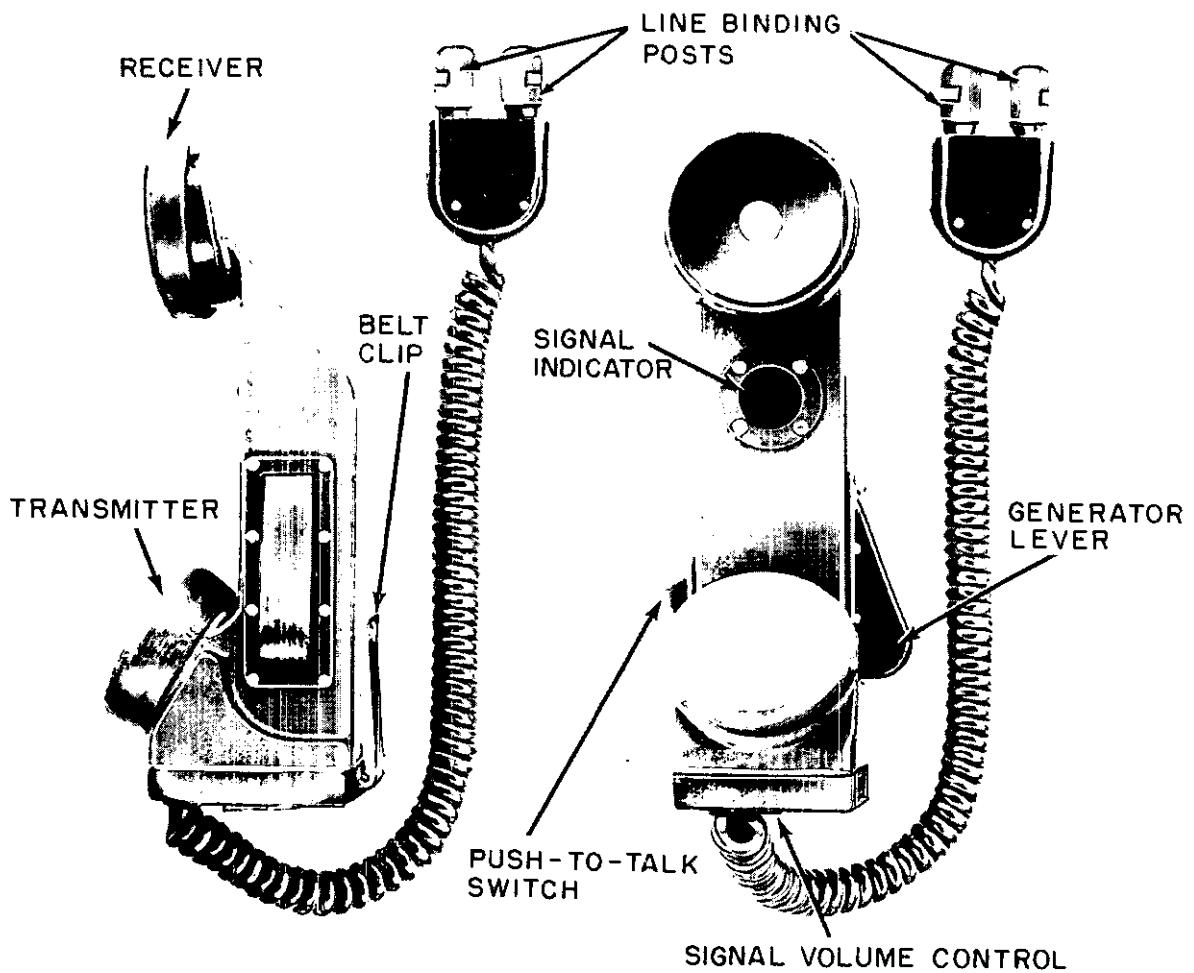


Figure 23. Telephone set TA-1/PT.

of the retaining slot. This procedure is reversed to replace the gaffs.

d. Gaff Sharpening. A new gaff may be used as a guide to sharpen dull gaffs; however, gaffs should be sharpened only when replacement gaffs are not available.

132. Lineman's Belt LC-23

Lineman's belt LC-23 consists of a leather belt and an adjustable leather safety strap. The body belt is supplied in various sizes, according to the distance in inches between the D-rings. Safety straps are furnished in 61-, 68-, and 70-inch lengths.

133. Field Telephones, General

a. Field telephone sets are portable, self-contained types of equipment designed for field use. These sets combine durable construction with portability. The selection of a specific field telephone depends on the length and type of the circuit and the type of switchboard to be used in the circuit.

b. The two principal types of field telephones are sound-powered and battery-powered.

(1) In a sound-powered telephone, the transmitter unit generates the electrical energy. The sound waves created by the voice of the speaker strike the transmitter unit and are converted directly into electrical energy. The receiver unit of the distant telephone reconverts this electrical energy to the original sound waves. Sound-powered telephones, which have a shorter voice range than battery-powered telephones, can be used with, or in the place of, local-battery telephones. Sound-powered telephones cannot be used in common-battery systems.

(2) In a local-battery-powered telephone, small dry-cell batteries normally contained inside the telephone, are the source of transmission power. When a local-battery-powered telephone is used in a common-battery system, dry-cell batteries inside the telephone may not (depending on the equipment) be necessary. Field telephones contain hand-operated magnetos or ringing generators for signaling. The incoming ringing signals are indicated audibly by a bell or buzzer or visually by a light or silent-type signal device.

c. The talking ranges of the principal field telephones are summarized, in the following table:

Field telephones	Talking distances, using telephone wire WD-1/TT (nonloaded)*	
	Wet conditions (miles)	Dry conditions (miles)
TA-1/PT.....	4	10
TA-312/PT.....	14	22
TA-264/PT:		
With amplifiers.....	33	60
Without amplifiers.....	12	18

*The above distances are approximate, since talking range is also affected by the number and quality of splices, weather conditions, the number of switching centrals and test stations, noise, cross talk, and other interference in a circuit.

134. Telephone Set TA-1/PT

a. Telephone set TA-1/PT (fig. 23) is a sound-powered type of equipment, providing facilities for talking and signaling without batteries. The approximate talking and signaling range of the TA-1/PT is from 4 to 10 miles over telephone wire WD-1/TT. This telephone set can be used to advantage in forward areas, in switched networks having magneto signaling switchboards, in closed nets, and in point-to-point circuits.

b. The telephone handset contains sound-powered transmitter and receiver units, a hand generator that is operated by a lever-type switch, and a push-to-talk switch. The user can receive either visual or audible-level signaling indications during operation.

c. To install the telephone, the wire conductors are connected to the binding posts on the terminal block at the end of the cord.

d. To signal the distant telephone, the generator lever is depressed and then released. To silence the audible signal, the switch at the back of the set is turned to OFF. The volume of the audible signal can be controlled by turning the switch to various settings between OFF and LOUD.

e. To talk to the distant station, the push-to-talk switch is depressed. It is possible to hear the distant party faintly if he tries to interrupt while the push-to-talk switch is depressed, but it is necessary to release the switch to hear him clearly.

f. For complete details on the operation, organizational maintenance, and repair parts of telephone set TA-1/PT, refer to TM 11-5805-243-12, and -20P.

135. Telephone Set TA-312/PT

a. Telephone set TA-312/PT (fig. 24) is a local-battery (LB) or common-battery telephone using common-battery signaling (CBS).

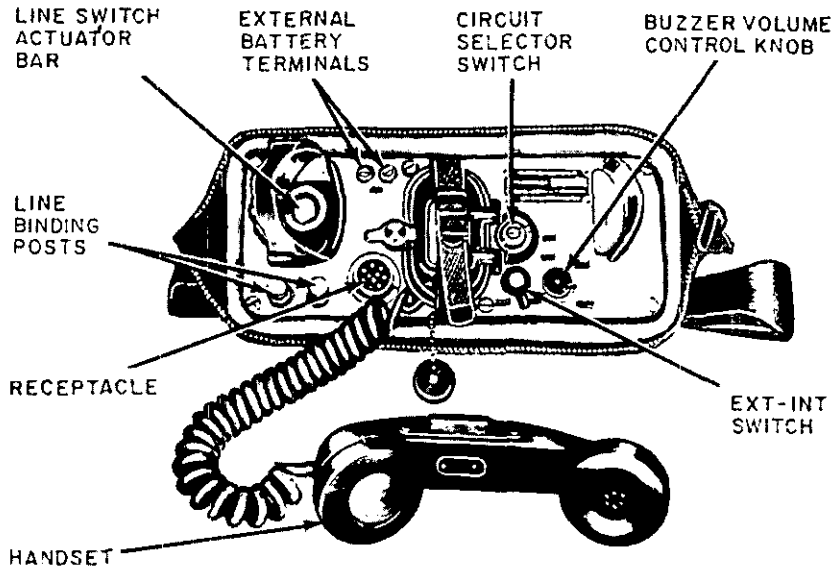


Figure 24. Telephone set TA-312/PT.

b. Telephone set TA-312/PT can be used under all outdoor conditions or as a desk or wall-mounted telephone. A receptacle is provided for connecting a handset-headset, which may be used in place of the handset provided. In addition, the telephone set can be used to control remotely operated radio equipment.

c. The rated operating range of the TA-312/PT is from 14 to 22 miles.

d. For complete details on the operation, organizational maintenance, and repair parts for telephone set TA-312/PT, refer to TM 11-2155.

136. Telephone Set TA-264/PT

a. Telephone set TA-264/PT (fig. 25) is a portable battery-powered field type of equipment designed for use on long field cable lines. Vacuum-tube amplifiers in both the transmitting and receiving circuits of the telephone make communication possible over greater distances than is possible with other field telephone sets. When the amplifiers are in use, communication is on a one-way reversible basis. The incoming ringing can be indicated audibly or visually.

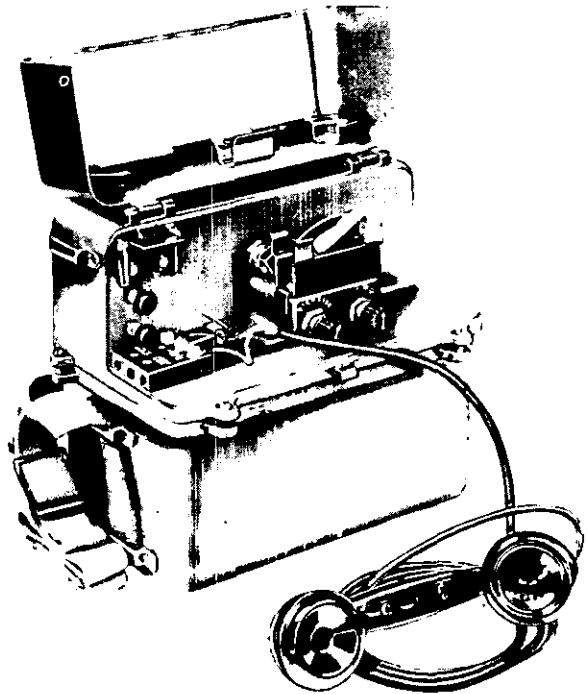


Figure 25. Telephone set TA-264/PT.

b. Telephone set TA-264/PT cannot be used in common-battery systems or over telephone carrier circuits.

c. For further information, refer to TM 11-2059.

137. Manual Telephone Switchboards, General

Manual telephone switchboards are designed for use in several types of operation; e.g., common-battery, local-battery, and common-battery signaling/local-battery operation. Some field switchboards are designed specifically for one type of operation. Others are designed for all three types of operation.

a. Field telephone switchboards are manually operated types of equipment, constructed to withstand rough handling and designed for quick, simple installation.

b. In a common-battery system, the source of electrical energy for speech and ringing signals is located at the switchboard telephone central. In a local-battery system, this source of electrical energy is located at the telephone set. In a common-battery signaling/local-battery operation system, the source of power for speech is located at the

telephone set; the power for signaling the switchboard is located at the switchboard.

138. Manual Telephone Switchboard SB-993/GT

a. Manual telephone switchboard SB-993/GT (fig. 26) is a light, portable, local-battery switchboard normally used in company-size units. The switchboard consists of a plug holder and seven 2-pronged adapter plugs U-184/GT in a case. A field telephone is required for the operator's use. The SB-993/GT may be used as an emergency field replacement for any local battery switchboard.

b. Each adapter plug U-184/GT consists of a neon glow lamp, two binding posts, two plugs, and two jacks, all molded together in a translucent plastic housing. The plugs serve as the thumb-screw ends of binding posts to which incoming lines are connected. The plugs may be inserted into the jacks of another adapter plug U-184/GT to establish a connection between two lines.

c. Several adapter plugs U-184/GT can be connected in tandem for conference connections (several separate parties connected together).

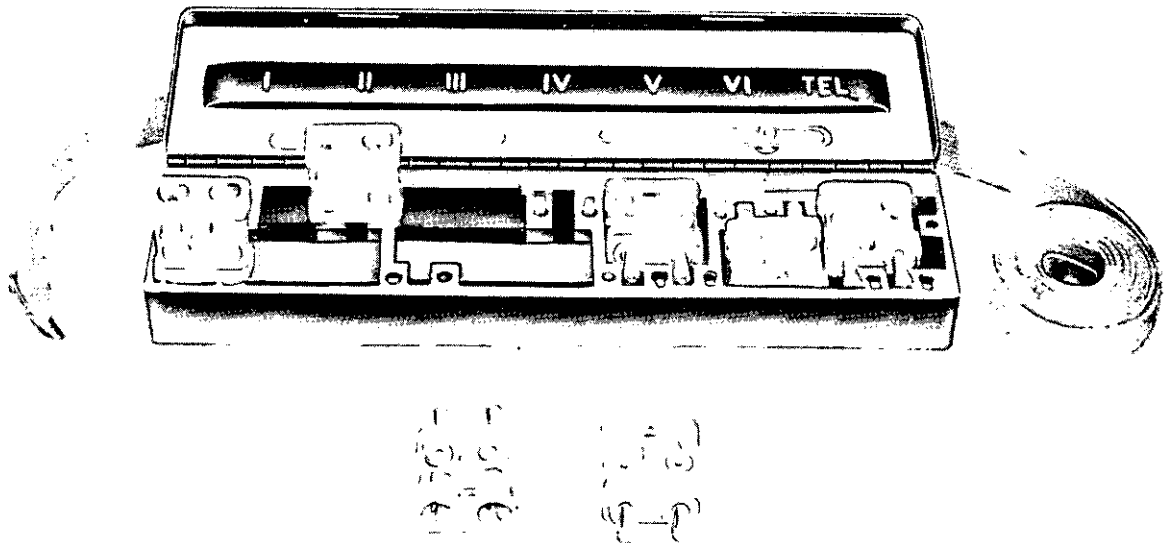


Figure 26. Manual telephone switchboard SB-993/GT.

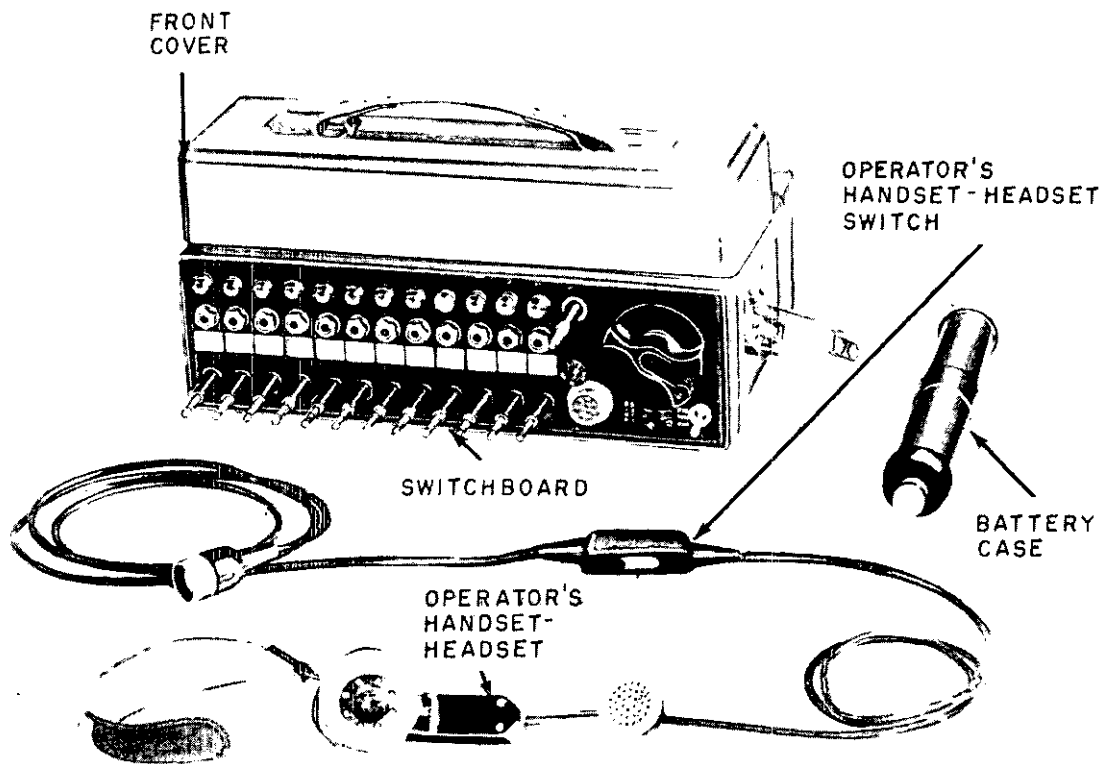


Figure 27. Manual telephone switchboard SB-22/PT.

d. An incoming ringing signal lights the neon lamp in the switchboard plug connected to the line for the duration of the signal. There is no audible signal when the neon lamp lights unless the switchboard operator's telephone is connected to that line. The operator must always be alert for an incoming signal.

139. Manual Telephone Switchboards SB-22/PT and SB-22A/PT

a. Manual telephone switchboards SB-22/PT and SB-22A/PT (fig. 27) are lightweight, local-battery, field-type switchboards that provide facilities for interconnecting 12 voice-frequency circuits. The SB-22/PT is normally used to interconnect local-battery telephone circuits, remote-controlled radio circuits, and voice-frequency teletypewriter circuits or a combination of these facilities. A capability of 29 circuits can be obtained by stacking two switchboards and replacing the operator's pack of one switchboard with five additional line jacks.

b. The SB-22/PT obtains operating power for transmitting and night alarm circuits from four batteries BA-30 or from an equivalent DC power source. A hand generator, mounted within the

operator's pack, furnishes 20 cycles per second, 90 to 100 volts for ringing.

c. The SB-22/PT and SB-22A/PT are identical except that in the SB-22A/PT, one of the line jacks, furnished in the accessory kit, is replaced by a trunk jack. The trunk jack is used on common battery signaling circuits.

d. For complete details on the operation, organizational maintenance, and repair parts, refer to TM 11-5805-262-12 and -20P.

140. Terminal Telephone Switchboard SB-86/P

a. Terminal telephone switchboard SB-86/P (fig. 28) is a portable, field-type switchboard used primarily in the field telephone cable system. The component parts of the switchboard can be rapidly assembled or dismantled during tactical employment. Switchboard SB-86/P can be used to interconnect voice-frequency teletypewriter circuits.

b. Terminal telephone switchboard SB-86/P consists of a portable jack field section, switchboard assembly TA-207/P, manual telephone switchboard section SB-248/P, and power supply PP-990/G.

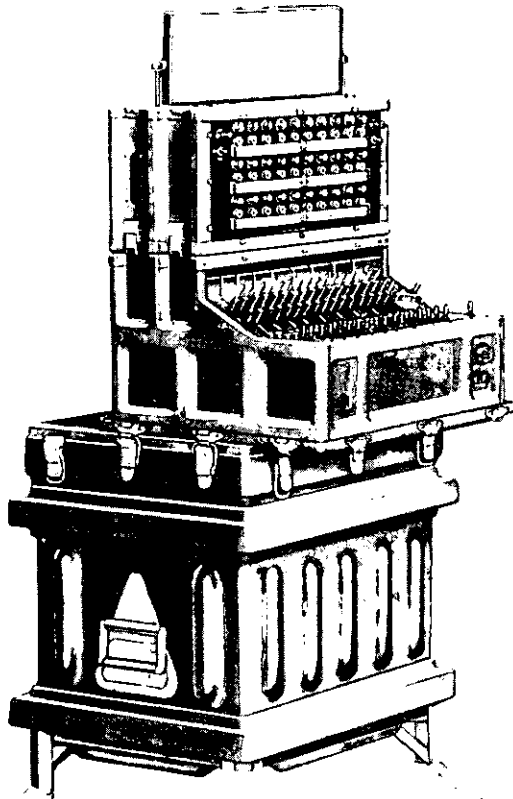


Figure 28. Terminal telephone switchboard SB-86/P.

- (1) The jack field section has a capacity of 30 complete line circuits. In addition, it contains the line signals, designation strips, panel lamps, and switches necessary for operation of the switchboard. A second jack field section can be stacked on the first to increase the capacity of the switchboard to 60 line circuits.
- (2) The switchboard section consists of eight replaceable cord packs, a cord telephone circuit TA-208/P, and an operator's circuit TA-220/P. Each TA-208/P has two answering and two calling cord circuits, four supervisory signals, and two cord circuit switches.

c. Local-battery or common-battery signaling can be selected by using a switch associated with each line circuit. There are also two common-battery

line circuits to be used with common-battery switchboards.

d. The cord circuits of the switchboard do not supply battery power to the distant telephone for speech transmission; therefore, only local-battery telephones or telephones designed for common-battery signaling can be used with this switchboard.

e. For further information, refer to TM 11-2134 and TM 11-5805-303-20P.

141. Teletypewriter Sets, General

a. A teletypewriter is an electromechanical machine for the transmission and reception of coded electrical impulses that are converted into a recorded message. Messages are recorded by either of two methods—typed page copy (page printing teletypewriters) or code perforations on tape (reperforators). Some teletypewriters that record messages by code perforations on the tape also record the typewritten characters on the same tape. Teletypewriter messages are transmitted manually by typing the message on a keyboard or by transmitting automatically from perforated tape in a transmitter-distributor.

b. A teletypewriter may require both alternating current (AC) and direct current (DC) power for its operation. Direct current must be used for the line signal circuit.

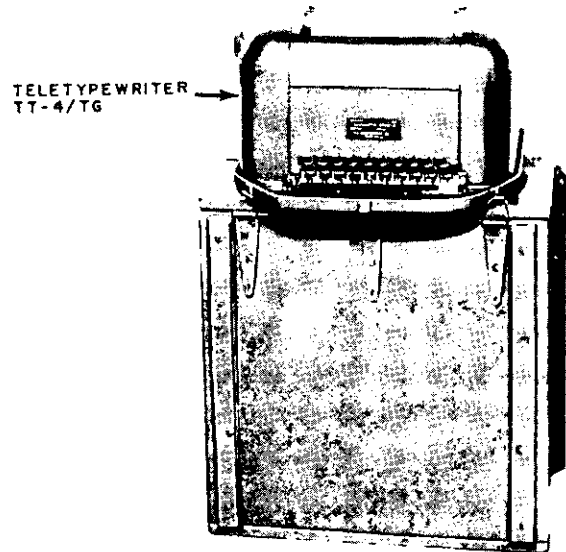


Figure 29. Teletypewriter set AN/PGC-1.

c. Tactical teletypewriter sets are equipped with carrying cases, and necessary accessories, such as recording paper, printing ribbons, and a supply of spare parts.

142. Teletypewriter Set AN/PGC-1

a. Teletypewriter set AN/PGC-1 (fig. 29) is a lightweight, portable, page-printing, sending and receiving set that is designed for field use. It consists of a standard communications teletypewriter (teletypewriter TT-4/TG) and case CY-594A/PGC-1.

b. Teletypewriter TT-4/TG is capable of sending and receiving standard teletypewriter start-stop, five-unit code impulses at speeds of 60, 66, 75, or 100 words per minute, depending on the motor-drive gear set used. It is designed for DC neutral or voice-frequency operation over cable circuits or as DC or voice-frequency operation over telephone carrier systems. The carrier systems may operate over spiral-four cable or radio relay carrier systems. Operation with either 20- or 60-milliamper DC line current is made possible by using a changeover switch.

c. Teletypewriter TT-4/TG is not equipped to supply DC power for the line current; this power

must be supplied by some external source. A power source of 105- to 125-volt alternating current or direct current is required to operate the teletypewriter.

d. For complete details on the operation, organizational maintenance, and repair parts for this equipment, refer to TM's 11-5815-206-12 and -20P.

143. Terminal Board TM-184

a. Terminal board TM-184 (fig. 30) is a block of insulating material on which are mounted 28 insulation-piercing binding posts and 4 mounting holes. This terminal board can terminate seven pairs of telephone wire.

b. To connect a wire to the terminal board, remove about one-half inch of insulation from the end of the conductor to be connected. Unscrew the knob on the binding post as far as possible and insert the end of the conductor into the slot so that it projects through the binding post.

c. As an alternate method, remove about 1 inch of insulation from the wire. Cut another 1-inch strip of insulation and move it to the end of the bared conductor. Double the bared portion and

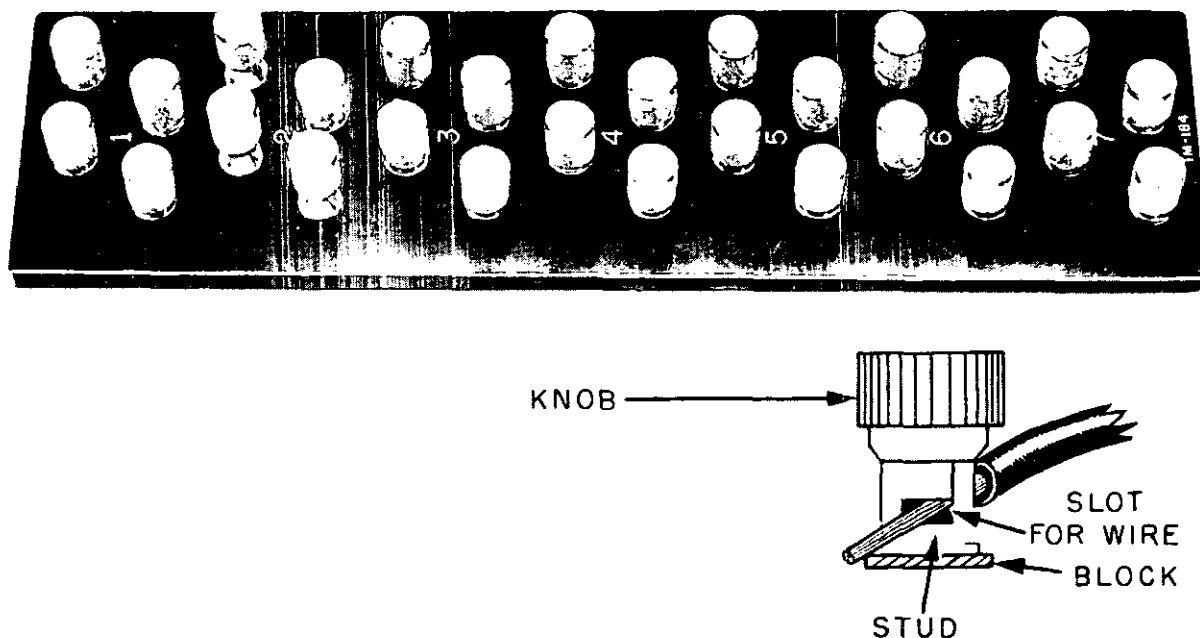


Figure 30. Terminal board TM-184.

insert it into the slot of the binding post. Tighten the knob firmly with the fingers, clamping the conductors securely in the slot. To avoid stripping the threads on the binding posts, do not use pliers to tighten or unscrew the knob.

d. Terminal boards mounted in the open and subject to the effects of weather must be protected. Since no prescribed cover is provided, covers must be improvised from any suitable material by the installing personnel.

144. Repeating Coils

a. A repeating coil is an audio-frequency transformer (usually with a 1-to-1 winding ratio) which transfers energy from one electrical circuit to another and permits the formation of simplex and phantom circuits for additional teletypewriter or telephone channels. The coils consist of two balanced windings. One winding—the line side—is connected to line terminals. The other winding—the switchboard side—is connected to switchboard terminals. When a telephone is used in place of a switchboard, these windings are connected to the telephone, and the line side of the coil is tapped at midpoint. This tap, called the leg, provides a means of forming simplex and phantom circuits.

b. Telephone repeating coil C-161 (fig. 31) is a ring-through transformer with a 1-to-1 winding ratio. The line-side winding of this transformer is tapped at the center for simplex or phantom circuit operation. The LINE binding posts are connected directly to the line, the SWITCHBOARD binding posts are connected to the line terminals on a switchboard or telephone, and the TELEG binding post is connected to one line terminal of a teletypewriter (except in a phantom circuit, in which case it is connected to the switchboard binding posts of the phantom cable).

c. Additional circuits can be obtained from existing metallic circuits with repeating coils. These circuits are as follows:

- (1) A simplex circuit is defined as a ground-return telephone or telegraph circuit superimposed on a single metallic circuit to obtain an additional circuit.
- (2) A phantom circuit is obtained from two metallic circuits to provide an additional telephone or telegraph circuit.
- (3) A simplex-phantom circuit combines the principles of both simplex and phantom circuits to obtain a fourth circuit.

d. For further information concerning repeating coils, refer to TM 11-678.

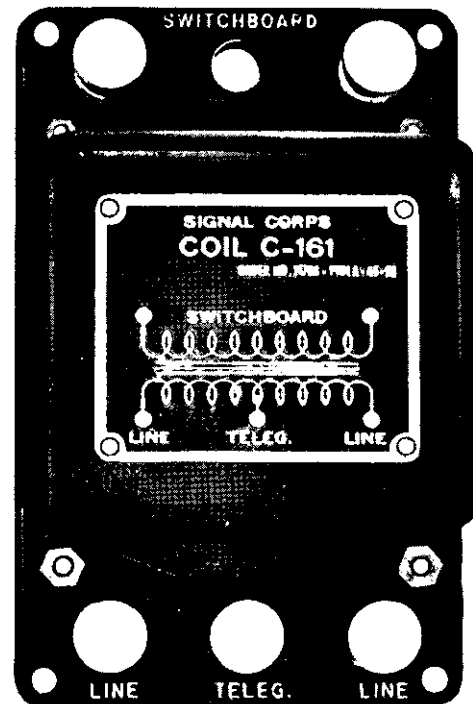


Figure 31. Telephone coil repeating C-161.

Section III. RADIO EQUIPMENT

145. General

This section contains general information concerning the characteristics of the major items of radio equipment used by field artillery units. For operating instructions and detailed information pertaining to this equipment, see the appropriate 11-series technical manuals. For type radio nets, see chapter 14. For detailed information on field radio techniques, see FM 24-18.

146. Radio Receiving Set AN/GRR-5

a. *General.* Radio receiving set AN/GRR-5 (fig. 32) is an amplitude modulated receiver which may be operated in a field, vehicular, or fixed installation. It consists of receiver R-174/URR and power supply PP-308/URR, plus necessary cables and accessories required for operation.

b. *Type of Reception.* The AN/GRR-5 will receive continuous wave (CW), modulated continuous wave (MCW), or voice signals.

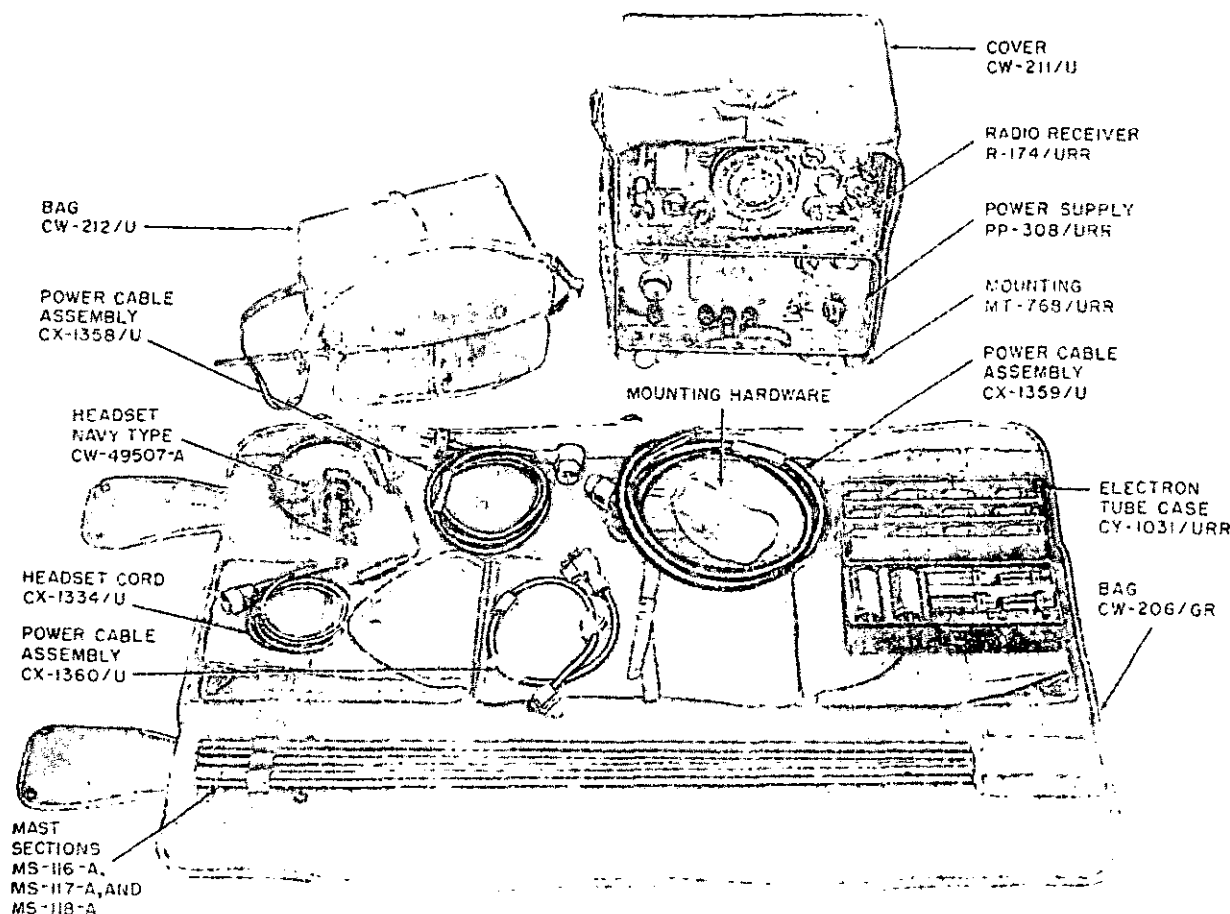


Figure 32. Radio receiving set AN/GRR-5.

c. Frequencies. The overall frequency coverage of the AN/GRR-5 ranges from 1.5 to 18.0 megacycles in four bands.

d. Method of Calibration. The receiver is equipped with a built-in crystal frequency oscillator for calibration, with calibration check points every 200 kilocycles, beginning at 1.6 megacycles.

e. Presets. The AN/GRR-5 features continuous tuning throughout its frequency range, with facilities available for mechanically presetting 10 channels.

f. Antenna. A four-section mast antenna or any suitable long-wire antenna may be used.

g. Power. The power input for the AN/GRR-5 may be furnished by any one of the following sources:

- (1) Dry batteries.
- (2) Storage batteries, 6-, 12- or 24-volt.
- (3) Commercial power (115-volt alternating current).

h. References. For complete details on the operation and maintenance of the AN/GRR-5, refer to TM 11-295.

147. Radio Set AN/GRC-19

a. General. Radio set AN/GRC-19 (fig. 33) is a medium-power, amplitude modulated radio used for transmitting and receiving voice and radiotelegraph (CW).

b. Range. The reliable operating range of radio set AN/GRC-19 is 50 miles.

c. Frequencies. The frequencies of the transmitter and receiver of the AN/GRC-19 are as follows:

- (1) Transmitter—From 1.5 to 20.0 megacycles in 10 bands.
- (2) Receiver—From 0.5 to 32.0 megacycles in 32 bands.

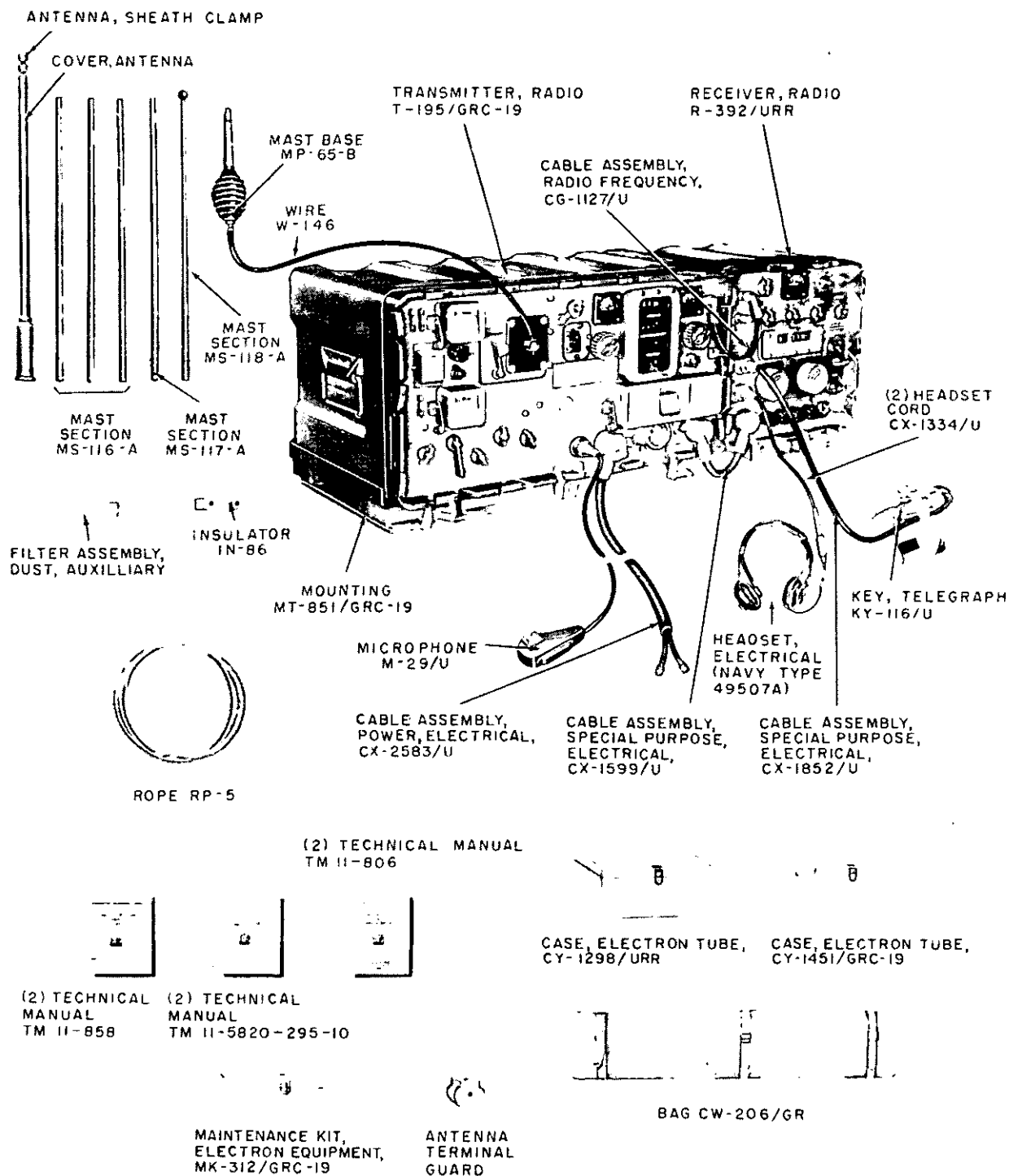


Figure 33. Radio set AN/GRC-19.

d. *Presets.* The transmitter operating frequency can be selected manually or automatically by any one of seven preset channels. There are no preset channels on the receiver.

e. *Power Input.* Input voltage is from 22 to 30 volts direct current (DC).

f. *Antenna.* Radio set AN/GRC-19 is also equipped with a 15-foot whip antenna. Antenna group AN/GRA-12 and AN/GRA-50 may be used although this equipment is not a component of the radio set.

g. *Type of Installation.* The AN/GRC-19 is designed for a mobile or semifixed installation.

h. *Remote Control.* Remote control of the transmitter (from distances up to 75 feet) is possible when the transmitter is used with transmitter control C-822/GRC-19 and a special purpose cable. The remote control unit turns the transmitter on and off and selects the type of service and the preset channels from the remote control position.

i. *Other Component Parts.* Other component parts of the AN/GRC-19 are the—

- (1) Necessary antenna installation equipment.
- (2) Telegraph key, microphones, headsets, and spare parts.

j. *References.* For complete details concerning the operation, organizational maintenance, and repair parts, refer to TM's 11-5820-295-10, -20, and -20P.

148. Radio Teletypewriter Set AN/GRC-46

a. The radio teletypewriter set AN/GRC-46 (fig. 34) consists of an assembly of transmitting, receiving, and teletypewriter equipment arranged in a shelter and mounted on a vehicle. The AN/GRC-46 can provide either separate or simultaneous transmissions and reception of voice and radio-teletype signals. In addition to the same transmitter and receiver used by the AN/GRC-19 radio, the AN/GRC-46 is equipped with a modulator, a frequency-shift converter, a teletypewriter reperforator, a teletypewriter, and an interconnecting box. All of the components are mounted in a shelter equipped with electric lights, a heater, a ventilation system, and blackout blinds. Although designed primarily for use in a $\frac{3}{4}$ -ton truck, the radio may be installed in any vehicle that is large enough to accommodate the shelter and which has a suitable electrical power system.

b. Technical characteristics are as follows:

- (1) Type installation: Vehicular (shelter on $\frac{3}{4}$ -ton truck).
- (2) Type modulation: Amplitude modulated.

(3) Type of emission: Voice, CW, or FSK (RATT) or voice and FSK simultaneously.

(4) Frequency range:

(a) Transmitter: 1.5 to 20 mc.

(b) Receiver: 0.5 to 32 mc.

(5) Transmission planning range (with whip antenna):

(a) Voice/FSK: 80 km (50 miles).

(b) CW: 80 km (50 miles).

(6) Power output (nominal): 100 watts.

(7) Power source: 22 to 30 volts direct current.

(8) Antenna:

(a) Whip 15 feet long (three MS-116, one MS-117, one MS 118).

(b) Doublet.

(9) Teletypewriter speed (automatic):
60 words per minute.

c. For detailed information concerning the operation, organizational maintenance, and repair parts, refer to TMs 11-5815-204-10, -20, and -20P.

149. Radio Set AN/VRC-24

a. The radio set AN/VRC-24 (fig. 35) is an ultra high frequency (UHF) amplitude modulated, voice communication equipment used for vehicular ground-to-air communication. It may also be used as a retransmission device for one of the AN/GRC-3 through -8 series radios.

b. Technical characteristics of radio teletypewriter AN/VRC-24 are as follows:

- (1) Frequency range—225.0 to 399.9 megacycles.
- (2) Communication channels—1,750.
- (3) Preset channels—19.
- (4) Power source—24 volts direct current.
- (5) Operating range—Depends on the line of sight or on the altitude of the aircraft. (About 30 miles at 1000 feet air elevation, 100 miles at 10,000 feet elevation.)
- (6) Antenna—A 10-inch vehicular antenna is provided with the set.
- (7) Type modulation—Amplitude.
- (8) Operation—Local or remote.

c. For information concerning the operation, organizational maintenance, and repair parts, refer to TMs 11-5820-222-10, -20, and -35.

150. Radio Sets AN/PRC-8, -9, and -10

a. *General.* Radio sets AN/PRC-8, -9, and -10 (fig. 36) are issued to armor, artillery, and infantry units, respectively as long as this series of radios are used. Artillery units supporting armor or infantry are also issued radio sets of the armor and infantry

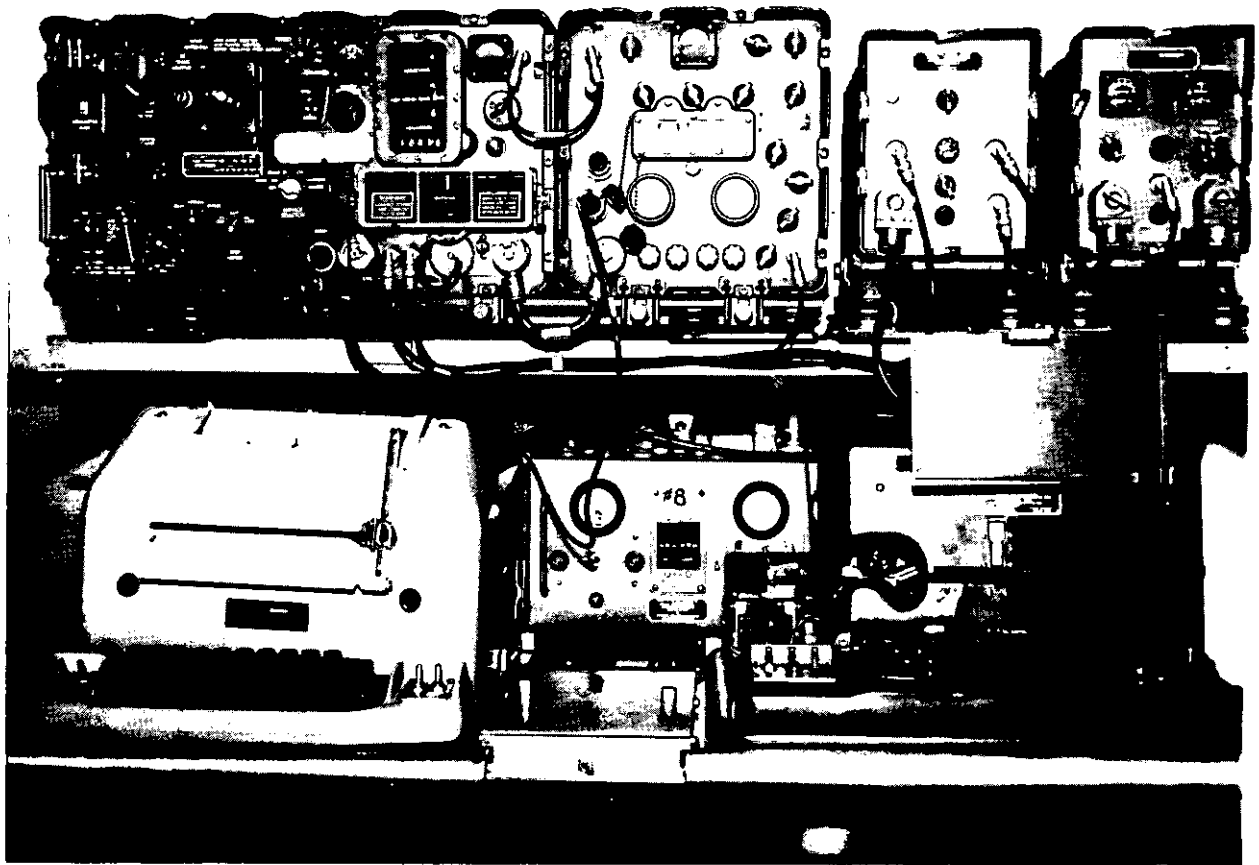


Figure 34. Radio teletypewriter set AN/GRC-46.

series. These radio sets are versatile, since they may be operated from a pack, ground, aircraft, or vehicular installation. The sets are basically identical—internally they differ in the equipment which determines the frequency of the radio signals transmitted and received; externally they differ in the calibration of the tuning dial. (For individual frequency ranges, see *d*(3) below.)

b. Frequency Overlap. A 1-megacycle overlap in frequency coverage between radio sets AN/PRC-8 and AN/PRC-9 provides 10 channels for communication between armor and artillery units. A similar overlap between radio sets AN/PRC-9 and AN/PRC-10 provides 10 channels for communication between artillery and infantry units.

c. Calibration. Continuously tunable throughout the frequency range, each radio set is equipped with a 1-megacycle crystal for calibration. Calibration is accomplished at each whole megacycle appearing

on the dial. On later models—the AN/PRC-8A, AN/PRC-9A, and AN/PRC-10A—calibration checkpoints are indicated by markers on the dial. The markers are 2.15 megacycles apart.

d. Characteristics. The general characteristics of radio sets AN/PRC-8, -9, -10 are as follows:

- (1) *Emission*—Voice (frequency modulated).
- (2) *Rated transmission range*—5 miles, or 8 kilometers.
- (3) *Frequency range*—AN/PRC-8 (armor): 20.0 to 27.9 megacycles; AN/PRC-9 (artillery): 27.0 to 38.9 megacycles; AN/PRC-10 (infantry): 38.0 to 54.9 megacycles.
- (4) *Power supply*—Dry battery BA-279/U (operating life approximately 20 hours) or battery BA-2279/U (for Arctic operation).
- (5) *Weight*—26 pounds.

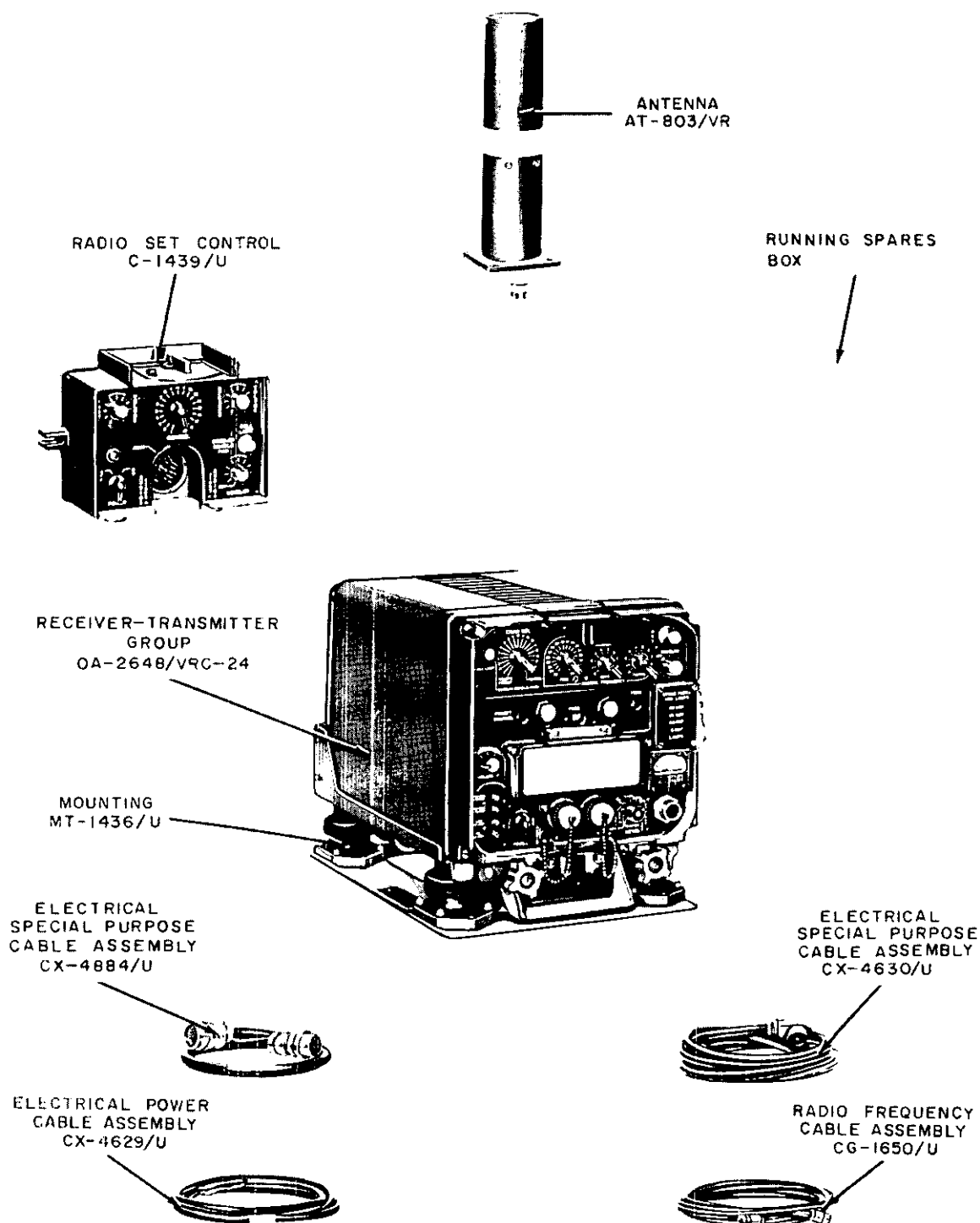


Figure 35. Radio set AN/VRC-24.

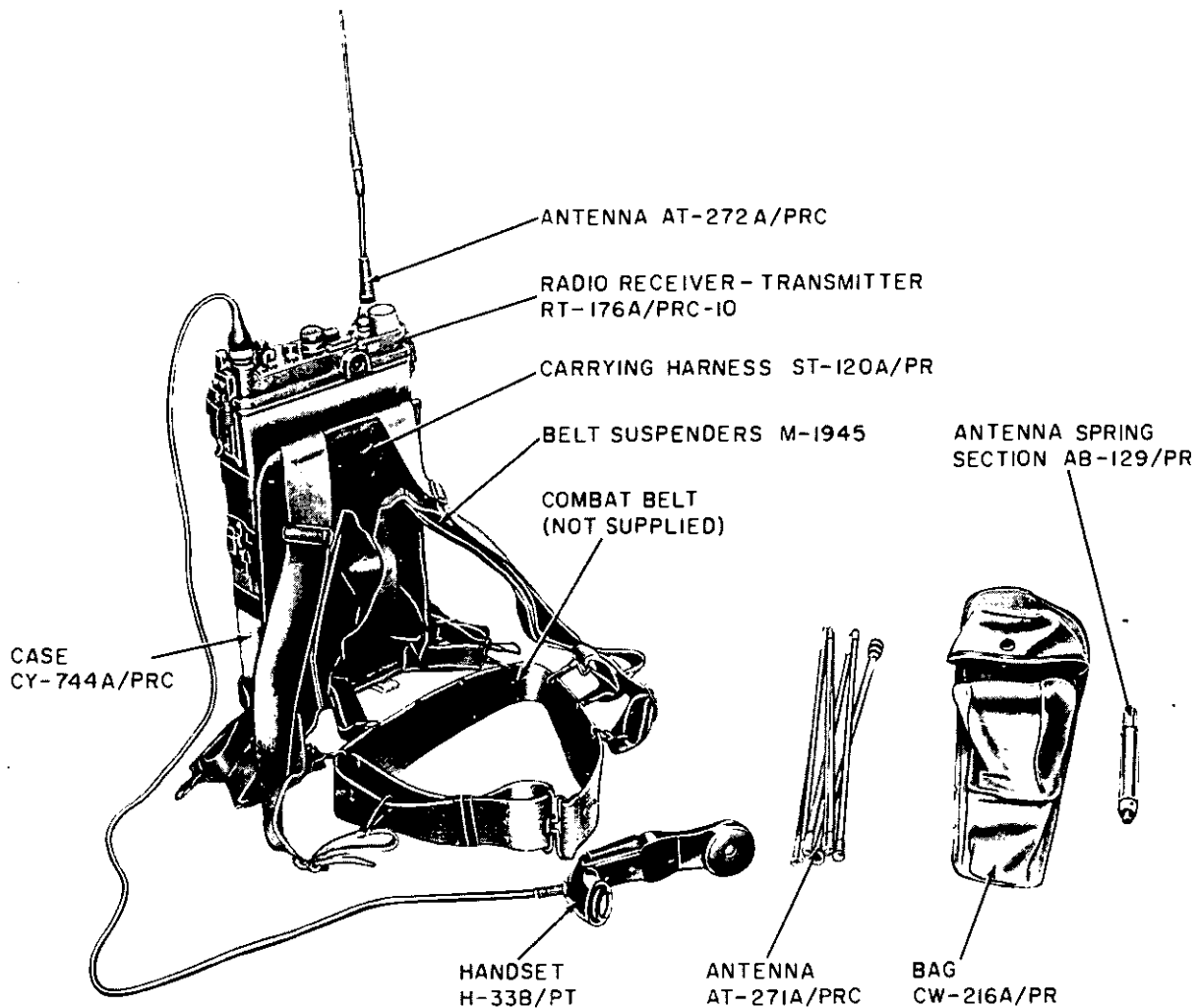


Figure 36. Radio sets AN/PRC-8, -9, and -10.

e. *Components.* The major components of radio sets AN/PRC-8, -9, and -10 are as follows:

- (1) For manpack operation—
 - (a) Radio receiver-transmitter RT-174/PRC-8, RT-175/PRC-9, or RT-176/PRC-10.
 - (b) Case CY-744/PRC.
 - (c) Antenna AT-271/PRC.
 - (d) Antenna AT-272/PRC.
 - (e) Antenna spring section AB-129/PR.
 - (f) Belt suspenders M-1945.
 - (g) Bag CW-216/PR.
 - (h) Carrying harness ST-120/PR.
 - (i) Handset H-33/PT.
- (2) For vehicular installation kit—
 - (a) Amplifier-power supply AM-598/U.

(b) Appropriate antenna and connections (TM 11-612 or SB 11-131).

f. *Installations.*

- (1) *Pack.* For pack installation, the radio set is fastened to the carrying harness ST-120/PR. The set is placed on the operator's back, and the carrying harness is fastened to a combat or cartridge belt. Dry battery BA-279/U (or BA-2279/U) and antenna AT-272/PRC are also necessary for manpack operation.
- (2) *Ground.* For ground installation, the radio set is placed upright on the ground with U-shaped runners on the battery case extended to provide stability. The dry battery is the power supply, and the long

antenna AT-271/PRC is used to obtain better operational reliability.

- (3) *Vehicular.* The amplifier power supply AM-598/U is necessary for vehicular installations. The antenna for vehicular installation of radio set AN/PRC-9 (artillery) consists of one mast section MS-116, one mast section MS-117, and one mast section AB-24.

g. References. For information concerning the operation, organizational maintenance, and repair parts, refer to TMs 11-5820-292-10, -20, and -20P.

151. Radio Set AN/VRC-9

Radio set AN/VRC-9 (fig. 37) is a medium-power, voice-operated, frequency modulated, two-way radio designed for communication between moving or stationary vehicles. This artillery radio set is used by individuals who need only one receiver-transmitter. The armor version of this set is the AN/VRC-8; the infantry version is the AN/VRC-10.

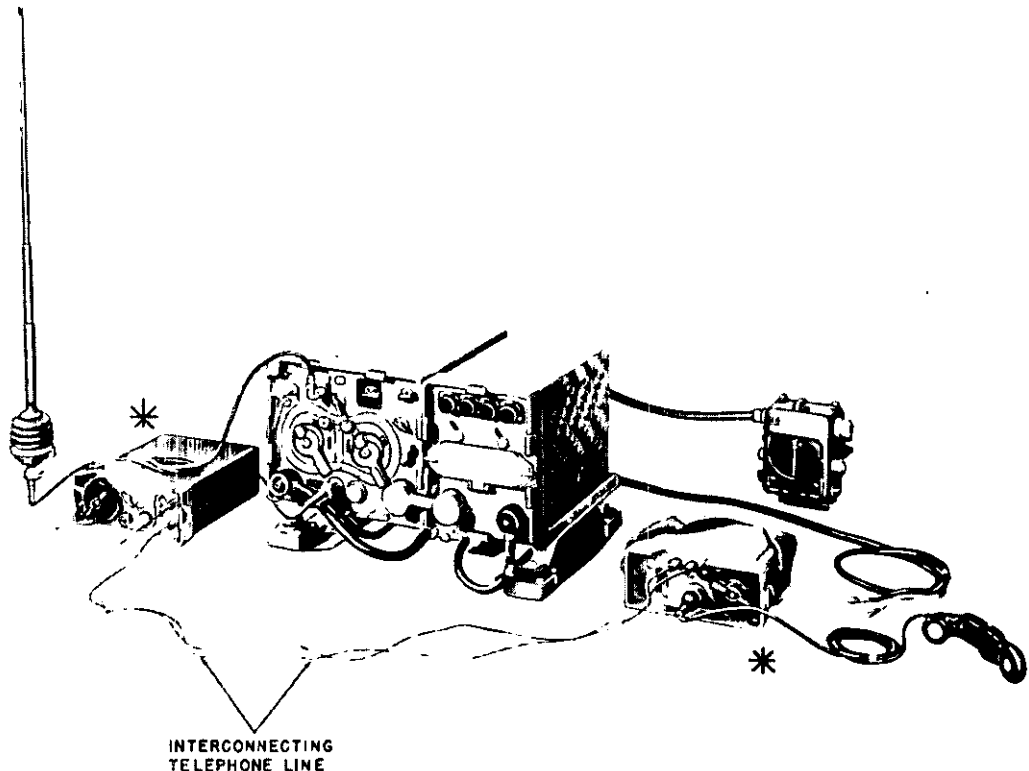
a. Components. The principal components of the AN/VRC-9 are—

- (1) Receiver-transmitter RT-67/GRC.
- (2) Power supply PP-109/GR or PP-112/GR.
- (3) Mounting MT-299/GR.

b. Installation. Radio set AN/VRC-9 can be installed and operated in any military vehicle equipped with either a 12- or 24-volt ignition system, but, because of the differences in the vehicles, detailed instructions for the exact location of components, routing of cables, placement of antennas, etc., will be limited. For specific details of installation, reference should be made to the instructions supplied with the installation units for the vehicle.

c. Characteristics. The general characteristics of radio set AN/VRC-9 are as follows:

- (1) *Emission*—Voice and 1,600-cycle ringing signal (frequency modulated).
- (2) *Rated transmission range*—10 to 15 miles, or 16 to 24 kilometers.



* NOT COMPONENTS

Figure 37. Radio set AN/VRC-9.

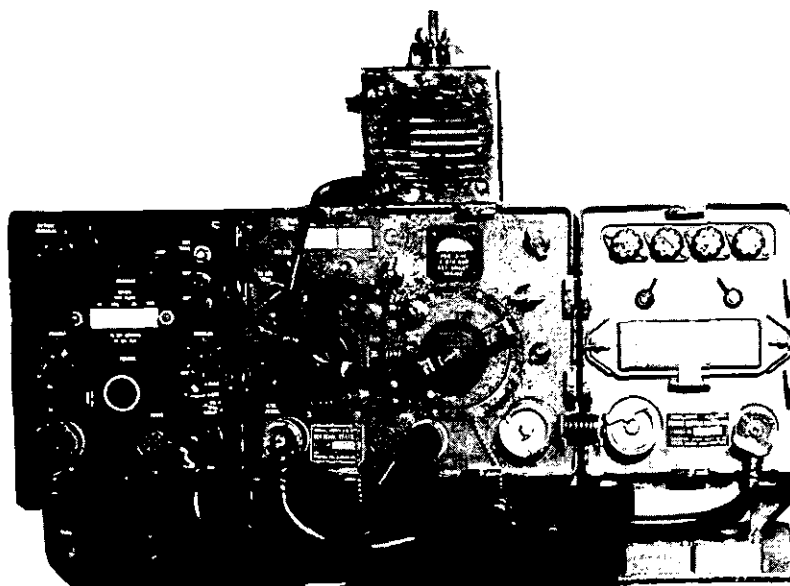


Figure 38. Radio set AN/VRC-17.

- (3) *Frequency range*—RT-66/GRC (armor): 20.0 to 27.9 megacycles; RT-67/GRC (artillery): 27.0 to 38.9 megacycles; RT-68/GRC (infantry): 38.0 to 54.9 megacycles.
- (4) *Number of operating channels*—RT-66/GRC (armor): 80 channels; RT-67/GRC (artillery): 120 channels; RT-68/GRC (infantry): 170 channels.
- (5) *Tuning*—Detent or continuous tuning with facilities for preselecting two of the operating channels.
- (6) *Power supply*—Power supplies PP-109/GR and PP-112/GR are vibrator-type power supplies that derive power from a 12-volt and a 24-volt storage battery, respectively. The power units are designed specifically to provide operating power for receiver-transmitter RT-66/GRC, RT-67/GRC, or RT-68/GRC.

d. Additional Information. For additional information concerning radio set AN/VRC-9, see TM 11-286.

152. Radio Set AN/VRC-17

Radio set AN/VRC-17 (fig. 38) employs the same components and provides the same facilities as radio set AN/VRC-9 with the following exceptions: The mounting of radio set AN/VRC-17 is larger in order to accommodate auxiliary receiver R-109/GRC. This receiver duplicates the frequency coverage of the receiver-transmitter RT-67/GRC

(set 1). The addition of another radio receiver makes it possible to monitor two channels simultaneously from control box C-375, or the receiver may be operated independently at its own front panel. Since the characteristics and capabilities of the receiver-transmitter RT-67/GRC (set 1) are described in paragraph 131, only receiver R-109/GRC will be discussed in this paragraph.

a. The general characteristics of receiver R-109/GRC are as follows:

- (1) *Frequency range*—27.0 to 38.9 megacycles.
- (2) *Number of operating channels*—120.
- (3) *Type of reception*—Voice and 1,600-cycle ringing tone (frequency modulated).
- (4) *Tuning*—Continuous tuning with facilities available for presetting any three of the operating channels.
- (5) *Power supply*—Internally installed. Power supply PP-448/GR, 6 volts; PP-281/GR, 12 volts; and PP-282/GRC, 24 volts.

b. For further information pertaining to radio set AN/VRC-17 see TM 11-611.

153. Radio Set AN/VRQ-2

Radio set AN/VRQ-2 (fig. 39) consists of two each of the major components of radio set AN/VRC-9. The technical characteristics and operational capabilities of receiver-transmitters RT-67/GRC are identical with those of radio set AN/VRC-9; the components that differ from those in the AN/VRC-9 are the mounting MT-298/GR and a

retransmission unit, control C-435/GRC. The terms "set 1" and "set 2" are used to distinguish between the two identical receiver-transmitters. Set 1 refers to the left-hand receiver-transmitter and power supply; set 2 refers to the right-hand receiver-transmitter and power supply.

a. The capabilities of radio set AN/VRQ-2 are as follows:

- (1) *Monitor or transmit on two frequencies.* Monitoring or transmitting on two frequencies with two receiver-transmitters RT-67/GRC (set 1 and set 2) is accomplished in the same manner as with one receiver-transmitter.
- (2) *Automatic retransmission.* Automatic retransmission is defined as the capability of the radio set to operate as an automatic relay station, receiving signals on one receiver-transmitter and automatically retransmitting the same signal on the other receiver-transmitter. In order to effect automatic retransmission, the retransmis-

sion unit, control C-435/GRC, must be installed in the mounting bracket.

- (3) *Duplex operation.* The retransmission unit C-435/GRC provides the switching circuits required for duplex operation. Duplex operation is the capability of the radio set for simultaneous communication in two directions. For duplex operation, turn the AUTO switch to the DUPLEX position. This action turns on set 1 and keys it continuously; set 2 then acts as a receiver only.

b. For further information pertaining to radio set AN/VRQ-2, see TM 11-287.

154. Radio Sets AN/VRC-12 and AN/VRC-43 through -49

a. Radio sets AN/VRC-12 and AN/VRC-43 through -49 are the most recent vehicular radio communication equipments designed for armor, artillery, and infantry units. The radio sets are frequency modulated and will replace radio sets

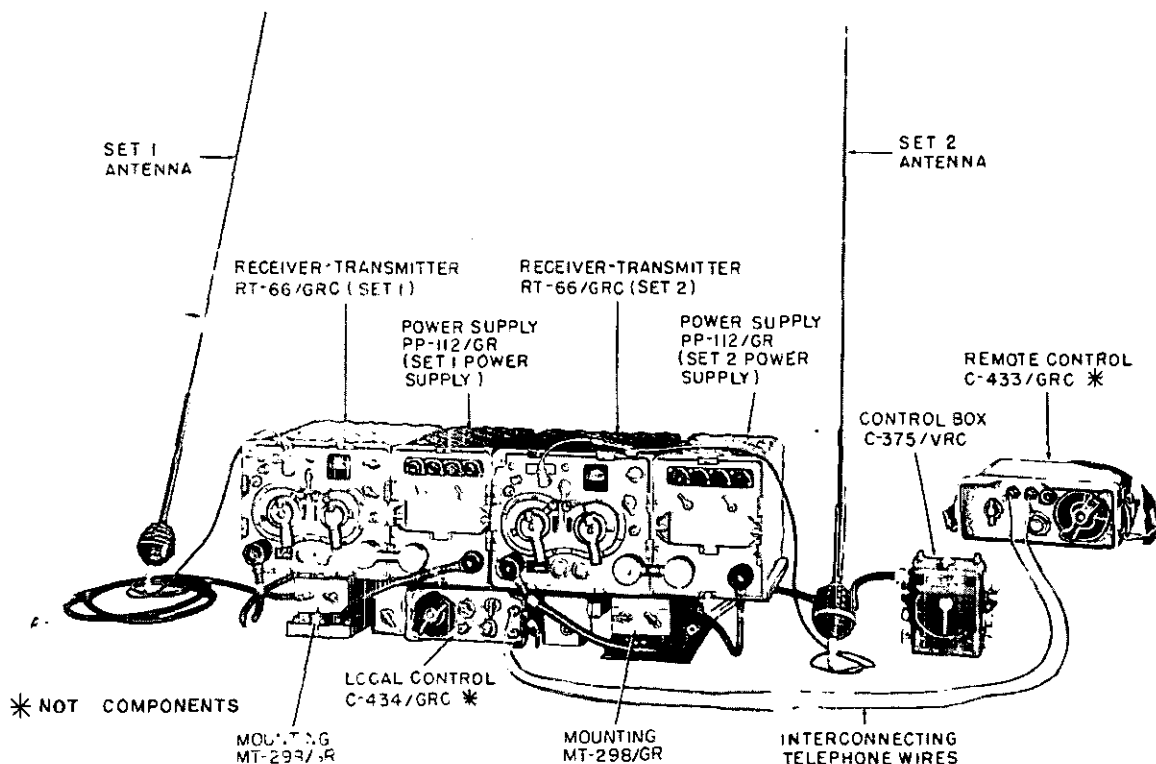


Figure 39. Radio set AN/VRQ-2.

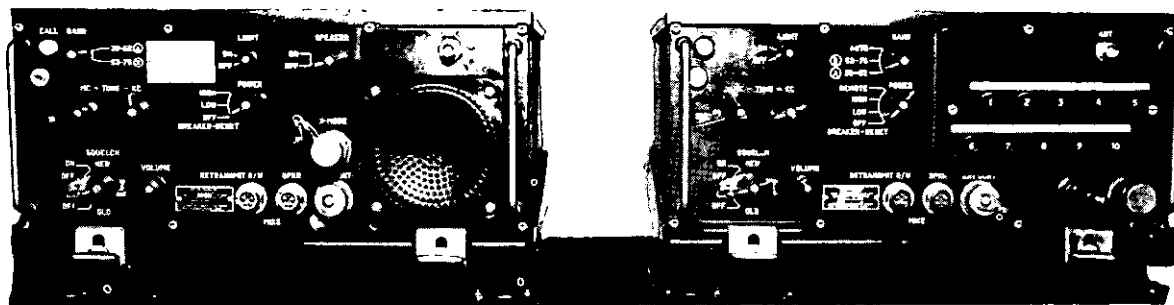


Figure 40. Radio receiver-transmitters RT-524/VRC and RT-246/VRC.

AN/GRC-3 through -8, AN/VRC-7 through -10, AN/VRC-13 through -18, AN/VRC-20 through -22, and AN/VRQ-1 through -3. All configurations of the new radio sets consist of various combinations of two basic components—a receiver-transmitter and an auxiliary receiver. There are two versions of the receiver-transmitter—a manually tuned model, the RT-524/VRC, and an automatically tuned model, the RT-246/VRC (fig. 40). Both models have the same characteristics. The manual model contains a built-in loudspeaker in the space occupied by the push-buttons of the automatic model. The manually tuned RT-524/VRC was developed primarily for issue to artillery and infantry units, since their need for a self-contained loudspeaker is greater than their need for automatic tuning. Armor units will be issued the automatic receiver-transmitter RT-246/VRC because of limited access in tracked vehicles. Any of the 10 preset channels can be remotely selected from crew positions. The auxiliary receiver R-442/VRC (fig. 41) is manually tuned. Each component of the new radio sets has its individual mount.

b. The characteristics of receiver-transmitters RT-524/VRC and RT-246/VRC are as follows:

- (1) Frequency range—30.00 to 75.95 megacycles.
 - (a) Band A—30.00 to 52.95 megacycles.
 - (b) Band B—53.00 to 75.95 megacycles.
- (2) Preset channels—10 (RT-246/VRC only).
- (3) Number of channels—920.
- (4) Channel spacing—50 kilocycles.
- (5) Type of modulation—Frequency modulation (FM).
- (6) Type of transmission and reception—Voice.
- (7) Transmitter power output:
 - (a) High power—35 watts, minimum.
 - (b) Low power—1 to 3 watts.

- (8) Distance range (high power):
 - (a) Stationary—20 miles.
 - (b) Moving—15 miles.
- (9) Input power requirements:
 - (a) High power—10 amperes at 25.5 volts direct current.

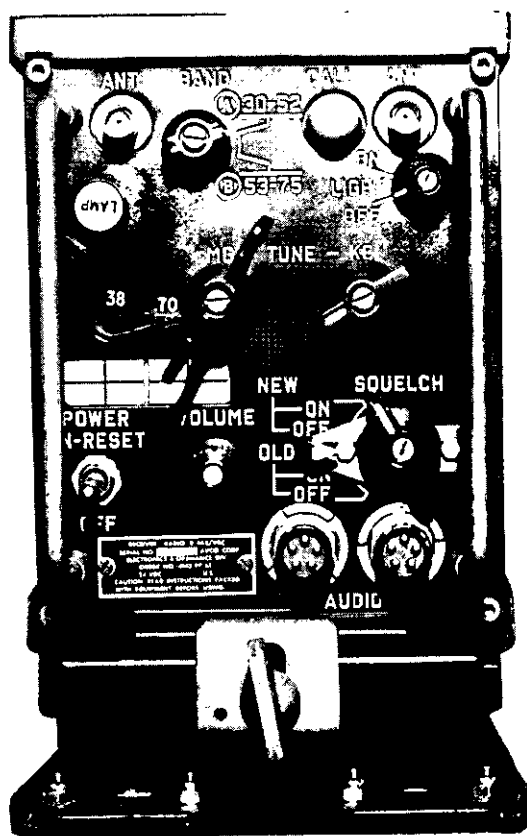


Figure 41. Radio receiver R-442/VRC.

(b) Low power—3 amperes at 25.5 volts direct current.

(10) Antenna—Center-fed whip.

(11) Types of squelch—Noise- and tone-operated.

c. The characteristics of radio receiver R-442/VRC are as follows:

(1) Frequency range:

(a) Band A—30.00 to 52.95 megacycles.

(b) Band B—53.00 to 75.95 megacycles.

(2) Number of channels—920.

(3) Channel spacing—50 kilocycles.

(4) Type of modulation—Frequency modulation (FM).

(5) Type of signal received—Voice.

(6) Types of squelch—Noise- and tone-operated.

(7) Antenna—Three-section whip (one MS-116, one MS-117, and one MS-118).

155. Radio Receiver R-442/VRC

Radio receiver R-442/VRC is a rugged, lightweight, compact receiver housed in a watertight case. All operating controls are located on the front panel. An electrical connector at the rear mates with a connector on the amount MT-1898/VRC. Two guide pin holes at the rear are recesses for the guide pins on the mount. The top and bottom covers are held in place by captive screws. The receiver is part of radio sets AN/VRC-12, AN/VRC-44 (armor), AN/VRC-47 and AN/VRC-48 (artillery and infantry).

156. Radio Receiver-Transmitter RT-246/VRC

Receiver-transmitter RT-246/VRC is a rugged, lightweight, compact receiver-transmitter housed in a watertight case. All operative controls are located on the front panel. The hinged cover, held in place by two captive screws in front of the pushbutton assembly, provides access to the presetting adjustments for maintenance personnel. The connector at the rear mates with a connector on the front of the junction box on the mount MT-1029/VRC. Two guide pin holes are recesses for the guide pins on the mount. The blower inside the case aids in dissipating heat. The top and bottom covers are held in place by captive screws.

157. Radio Receiver-Transmitter RT-524/VRC

Receiver-transmitter RT-524/VRC is similar to receiver-transmitter RT-246/VRC except that it has a self-contained loudspeaker instead of a pushbutton assembly on the front panel.

158. Radio Set AN/VRC-12

The radio set AN/VRC-12 (fig. 42) provides facilities for monitoring two channels simultaneously or for monitoring one channel while transmitting on another. It has 10 preset channels and is used by armor units. For additional information on radio set AN/VRC-12, refer to TM 11-5820-401-10.

159. Radio Set AN/VRC-47

The radio set AN/VRC-47 (fig. 43) provides facilities for monitoring two channels simultaneously or for monitoring one channel while transmitting on

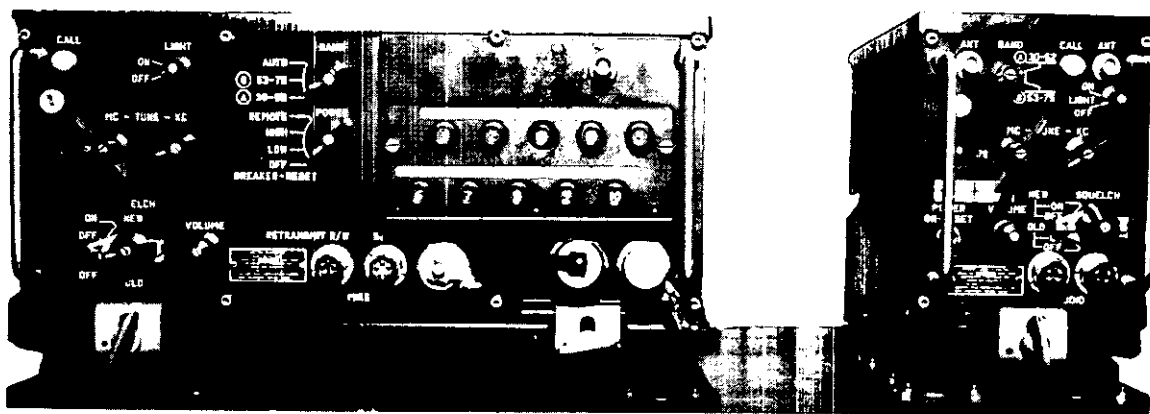


Figure 42. Radio set AN/VRC-12.

another. It is a manually tuned radio set and is used by artillery and infantry units.

a. *Components.* The principal components of the AN/VRC-47 are—

- (1) Radio receiver-transmitter RT-524/VRC.
- (2) Radio receiver R-442/VRC.
- (3) Mounting MT-1029/VRC.
- (4) Mounting MT-1898/VRC.
- (5) Antenna AT-912/VRC.

b. *Characteristics and Capabilities.* See paragraphs 154 through 158 for the characteristics and capabilities of radio set AN/VRC-47.

160. Radio Set AN/VRC-46

Radio set AN/VRC-46 (fig. 44) is similar to the AN/VRC-47 except for the absence of auxiliary receiver R-442/VRC. It is a manually tuned radio set and is used by artillery and infantry units.

a. *Components.* The principal components of the AN/VRC-46 are—

- (1) Radio receiver-transmitter RT-524/VRC.
- (2) Mounting MT-1029/VRC.
- (3) Antenna AT-912/VRC.

b. *Characteristics and Capabilities.* See paragraph 154 for the characteristics and capabilities of radio set AN/VRC-46.

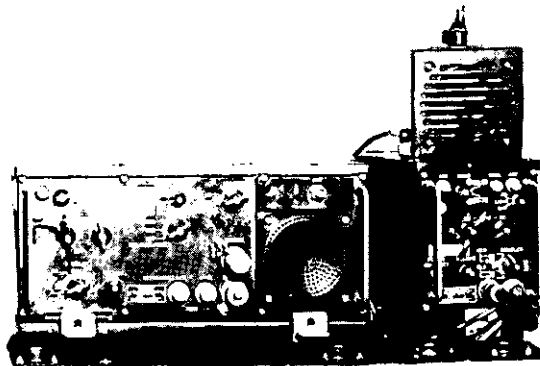


Figure 43. Radio set AN/VRC-47.

161. Radio Set AN/VRC-49

The radio set AN/VRC-49 (fig. 45) provides facilities for monitoring two channels simultaneously, transmitting on two channels simultaneously, or monitoring one channel while transmitting on another. In addition, the radio set control C-2299/VRC is used to control automatic retransmission between two distant stations.

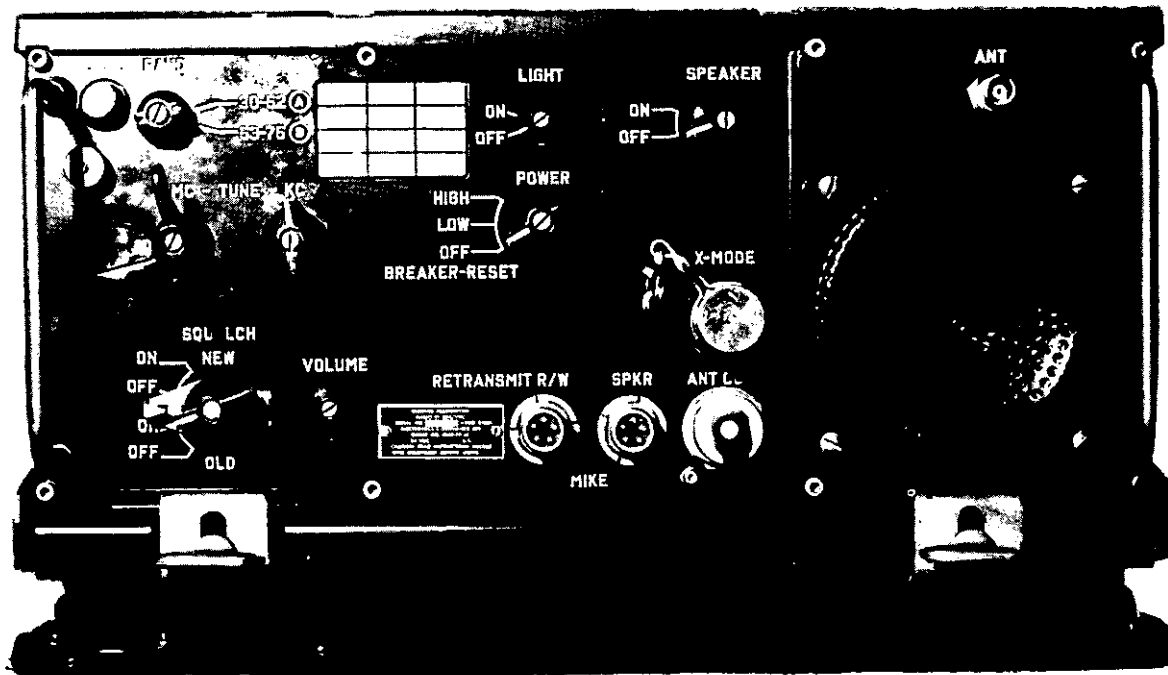


Figure 44. Radio set AN/VRC-46.

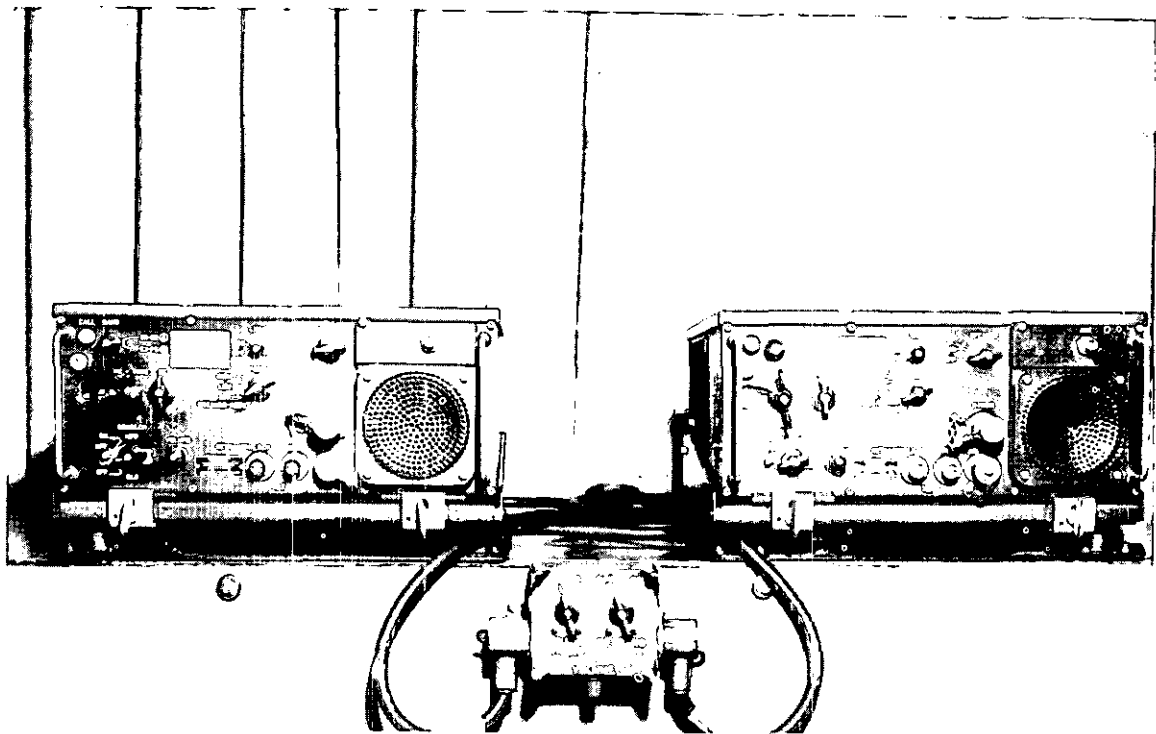


Figure 45. Radio set AN/VRC-49.

a. Components. The principal components of the AN/VRC-49 are—

- (1) Two radio receiver-transmitters RT-524/VRC.
- (2) Two mountings MT-1029/VRC.
- (3) Two antennas AT-912/VRC.
- (4) One radio set control C-2299/VRC.

b. Characteristics and Capabilities. See paragraph 154 for the characteristics and capabilities of radio set AN/VRC-49.

162. Radio Set AN/PRC-25

a. General. Radio set AN/PRC-25 (fig. 46) is both a portable and a vehicular-mounted FM receiver-transmitter designed to replace the present radio sets AN/PRC-8, -9, and -10. It is powered by a dry battery or by a special vehicular power supply. The radio set AN/PRC-25 will net with the AN/VRC-12-series. It is, however, a smaller set designed to operate over shorter distances. The basic radio set is referred to simply as the AN/PRC-25; however, recent nomenclature assignments have made the following distinctions in the use of the basic radio receiver-transmitter RT-505/PRC-25:

- (1) Manpack operation only—Radio set AN/PRC-25.

- (2) Vehicular operation only—Radio set AN/VRC-53.
- (3) Manpack or vehicular operation—Radio set AN/GRC-125.

b. Characteristics. The characteristics of radio receiver-transmitter RT-505/PRC-25 are as follows:

- (1) Frequency range:
 - (a) Low band—30.00 to 52.95 megacycles.
 - (b) High band—53.00 to 75.95 megacycles.
- (2) Preset channels—two.
- (3) Number of channels—920.
- (4) Channel spacing—50 kilocycles.
- (5) Type of modulation—Frequency modulation.
- (6) Type of transmission and reception—Voice.
- (7) Transmitter power output—1.5 to 2.0 watts.
- (8) Type of squelch—Tone-operated.
- (9) Operating range—5 miles (8 kilometers).
- (10) Antennas:
 - (a) AN/VRC-53—AT-912/VRC, center-fed whip.
 - (b) AN/GRC-125—AT-912/VRC, center-fed whip; AT-271A/PRC, 10-foot multi-section whip; AT-892/PRC-25, 3-foot semirigid tape.

- (c) AN/PRC-25—AT-271A/PRC, 10-foot multisection whip; AT-892/PRC-25, 3-foot semirigid tape.
- (11) Battery life—20 hours with a 9 to 1 receive-transmit ratio.
- (12) Power supply—Amplifier-power supply group OA-3633/GRC used with AN/VRC-53 and AN/GRC-125. Input voltage is 24 volts direct current.

163. Description of Radio Receiver-Transmitter RT-505/PRC-25

The radio receiver-transmitter RT-505/PRC-25 (fig. 46) is housed in a watertight metal case and secured with four captive screws. All controls are on the front panel. A battery plug projects from the RT-505/PRC-25 and mates with the connector of the battery BA-386. Battery box CY-2562/PRC-25 is part of the RT-505/PRC-25. It is a lightweight, metal case that houses and protects

the battery BA-386. The battery rests on a foam rubber pad fastened to the bottom of the case.

164. Retransmission Cable Kit MK-456/G

Two radio sets AN/PRC-25 at a suitable location may be used to retransmit automatically the signals of two other radio sets that are too far apart to communicate directly with each other. This action can be accomplished by connecting the retransmission cable kit MK-456/G between the two sets. The MK-456/G consists of an 18-foot cable with a five-pin connector at each end and a junction box at the center. The junction box has a connector for a handset H-138/U which permits the operator to monitor the retransmission signals. For additional information, refer to TM 11-5820-398-10.

165. Radio Terminal Set AN/TRC-80

a. The radio terminal set AN/TRC-80 (fig. 47) operates under the principle of tropospheric scatter communication and is a component of the Pershing

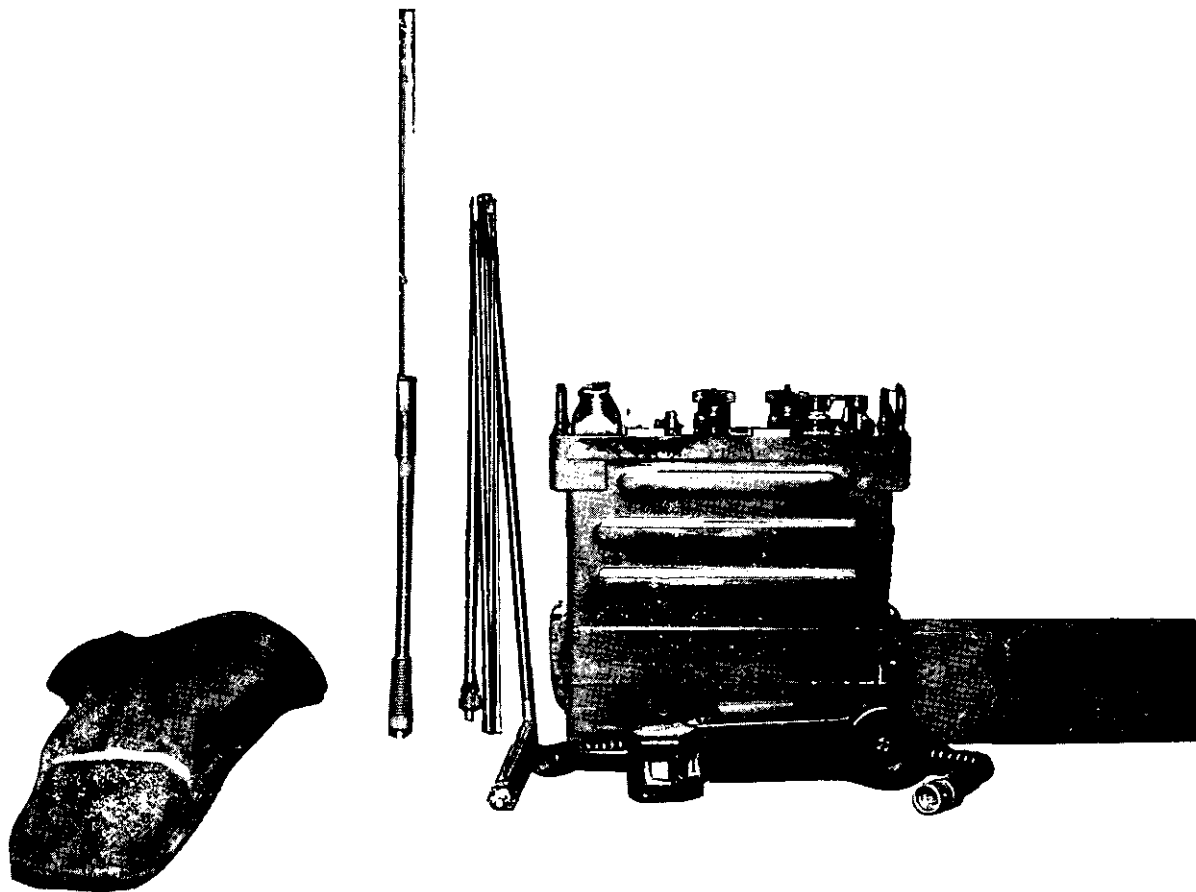


Figure 46. Radio set AN/PRC-25.

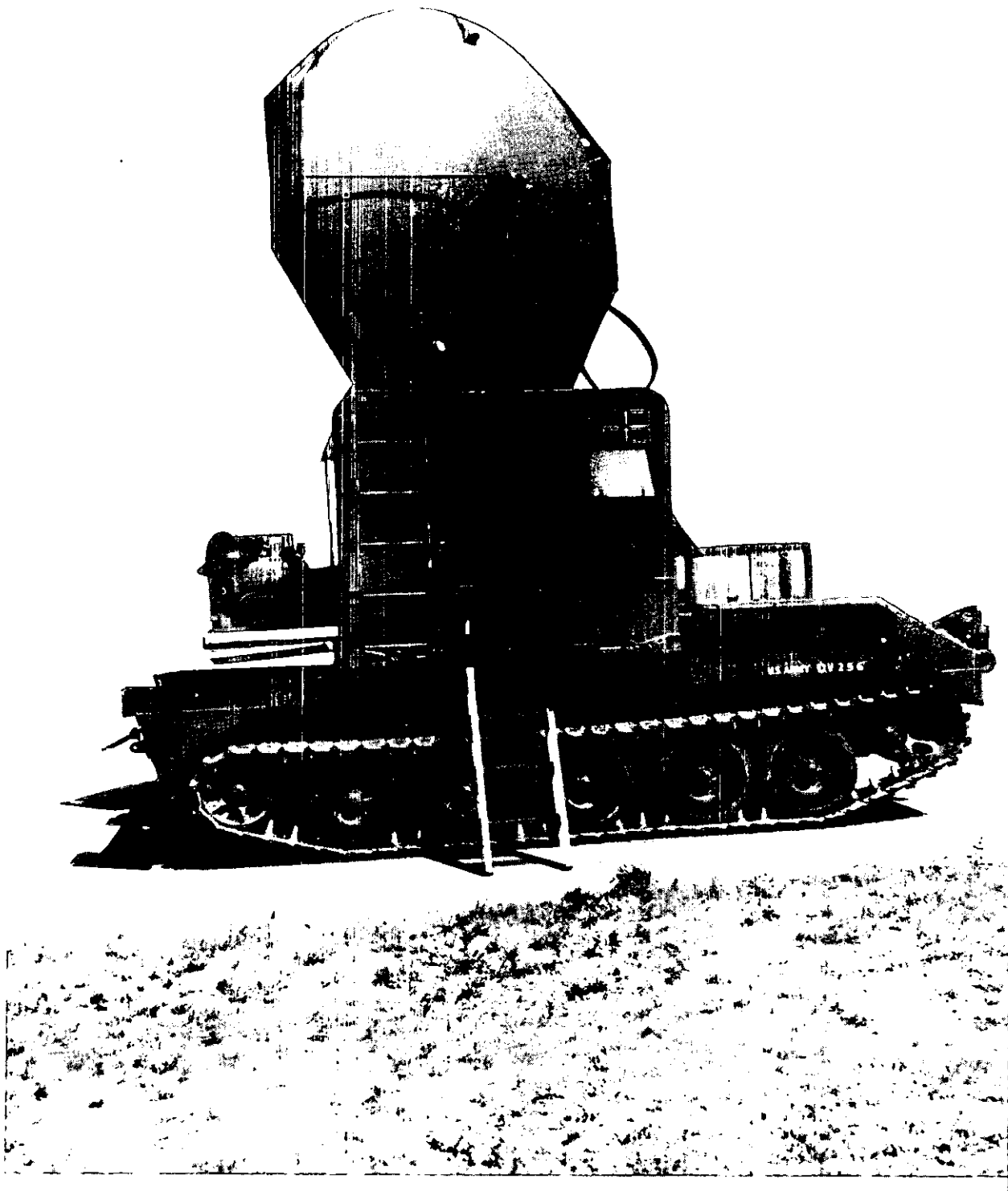


Figure 47. Radio terminal set AN/TRC-80 and tracked vehicle M474.

missile system. Each AN/TRC-80 consists of one transmitter and two receivers and has an 8-foot air-inflatable parabolic antenna and a 10-kilowatt generator, all contained in a shelter mounted on a vehicle (M474). The AN/TRC-80 is highly directional and must be map oriented; it is immune to all known electronic countermeasures.

b. The characteristics of radio terminal set AN/TRC-80 are as follows:

- (1) Range:
 - (a) Nondiversity operation—70 miles.
 - (b) Diversity operation—100 miles.
- (2) Operational reliability—99.9 percent.
- (3) Approximate weight—4,800 pounds.
- (4) Communication capability—Voice and teletype with on-line security.
- (5) Frequency—4,400 to 5,000 megacycles (super high frequency (SHF)).
- (6) Channels—333 at 1.8 megacycle intervals.
- (7) Type of modulation—Frequency modulation.
- (8) Power output—1000 watts.
- (9) Beam width—35 mils (about 2°).

c. The characteristics of the powerplant are as follows:

- (1) Type—Gasoline-engine-driven alternator.
- (2) Rating—10 kilowatts.
- (3) Voltage—208/120 volts, 3-phase.
- (4) Cycles—400.

166. Control Group AN/GRA-6

The primary purpose of control group AN/GRA-6 is to permit locating the radio sets to gain the line of sight which is necessary because of high operating frequencies. Control group AN/GRA-6 (fig. 48) is intended for use with frequency modulated radios for voice emission only, but it can be used with all FM radios issued to the artillery except the AN/PRC-6 and the new AN/VRC-12-series of radios. It may also be used to remote the voice portion of the AN/GRC-19 and AN/GRC-46. Dependable operation, using standard telephone wire, may be expected through the rated range of 2 miles.

a. The principal components of the AN/GRA-6 are—

- (1) Local control unit (C-434/GRC).
- (2) Remote control unit (C-433/GRC).
- (3) Handset H-33/PT.
- (4) Bag CW-189/GR.
- (5) Loudspeaker LS-166/U.
- (6) Interconnecting box J-654/G.

b. The capabilities of control group AN/GRA-6 permit—

- (1) Telephone communication between the local and remote control units (anytime the two units are interconnected by field wire).
- (2) Local push-to-talk operation (AN/PRC-9, AN/VRC-9, AN/VRC-17, and AN/VRQ-2).

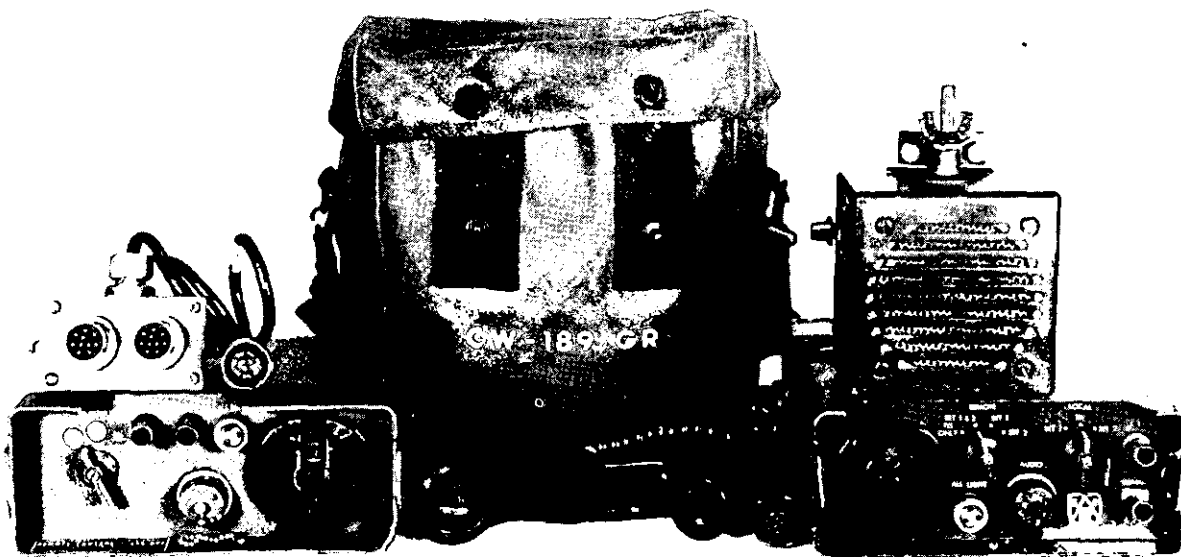


Figure 48. Control group AN/GRA-6.

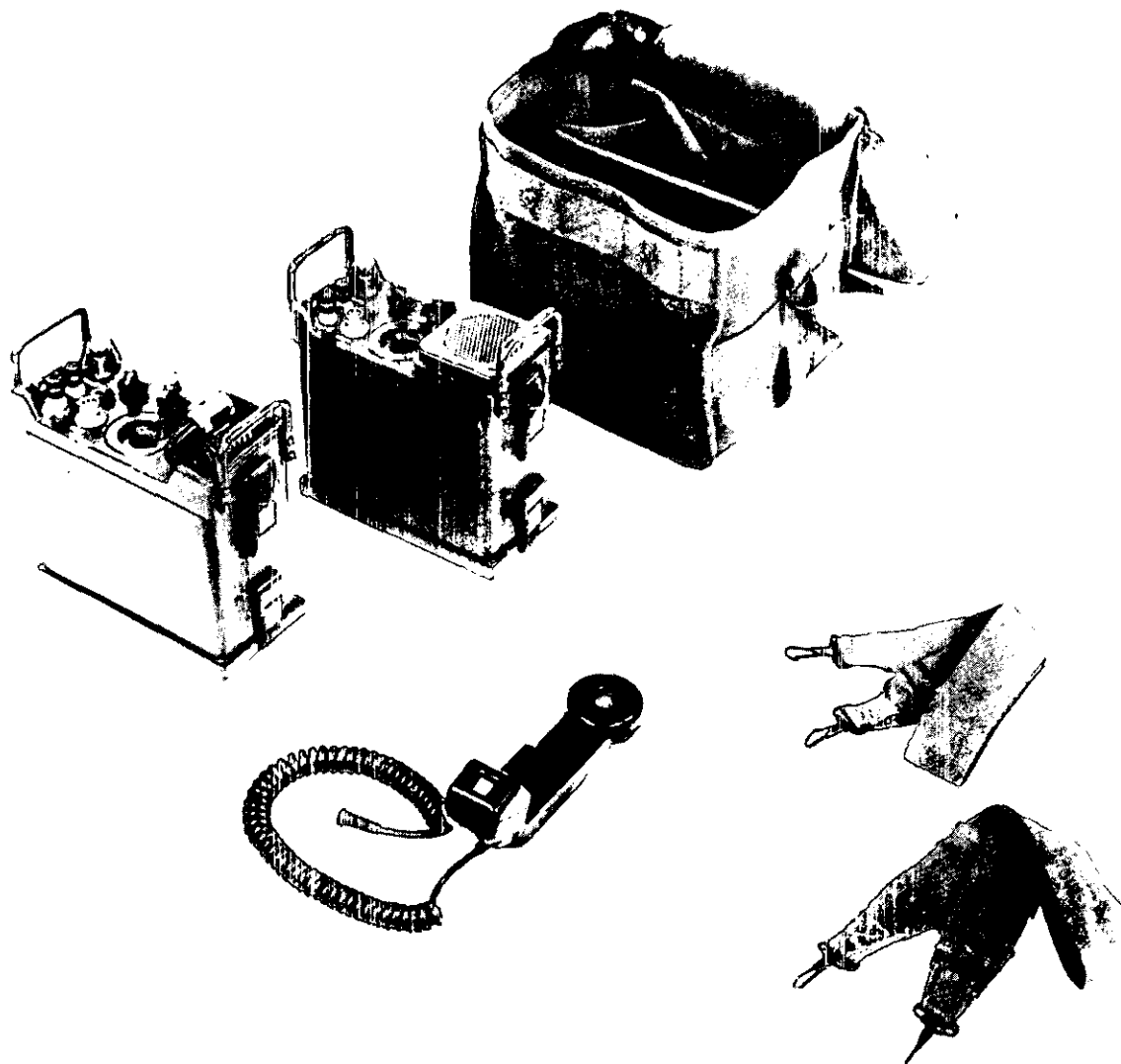


Figure 49. Radio set control AN/GRA-39.

- (3) Remote push-to-talk operation (AN/PRC-9, AN/VRC-9, AN/VRC-17, and AN/VRQ-2).
- (4) Remote power control (AN/VRQ-2 and AN/PRC-9).

c. For additional information, see TM 11-5038.

167. Radio Set Control AN/GRA-39

Radio set control AN/GRA-39 (fig. 49) is used with radio sets AN/VRC-12, AN/VRC-43 through -49, AN/PRC-25, AN/VRC-53, AN/GRC-125, and other similar tactical radio sets. The AN/GRA-39 allows voice transmission or reception through a radio set from a distance up to 2 miles. Voice transmission or reception through a radio set

is established from either the C-2328/GRA-39 (remote control unit) or C-2329/GRA-39 (local control unit) at the option of the operator. Provision is also made for voice communication between the local and remote operators.

a. The characteristics of the remote control and local control units of radio set control AN/GRA-39 are as follows:

- (1) Radio set control C-2328/GRA-39 (remote control unit):
 - (a) Number of transistors—seven.
 - (b) Control distance (max)—2 miles.
 - (c) Operating voltage—9.0 to 6.6 volts direct current.
 - (d) Power supply—Six batteries BA-30.

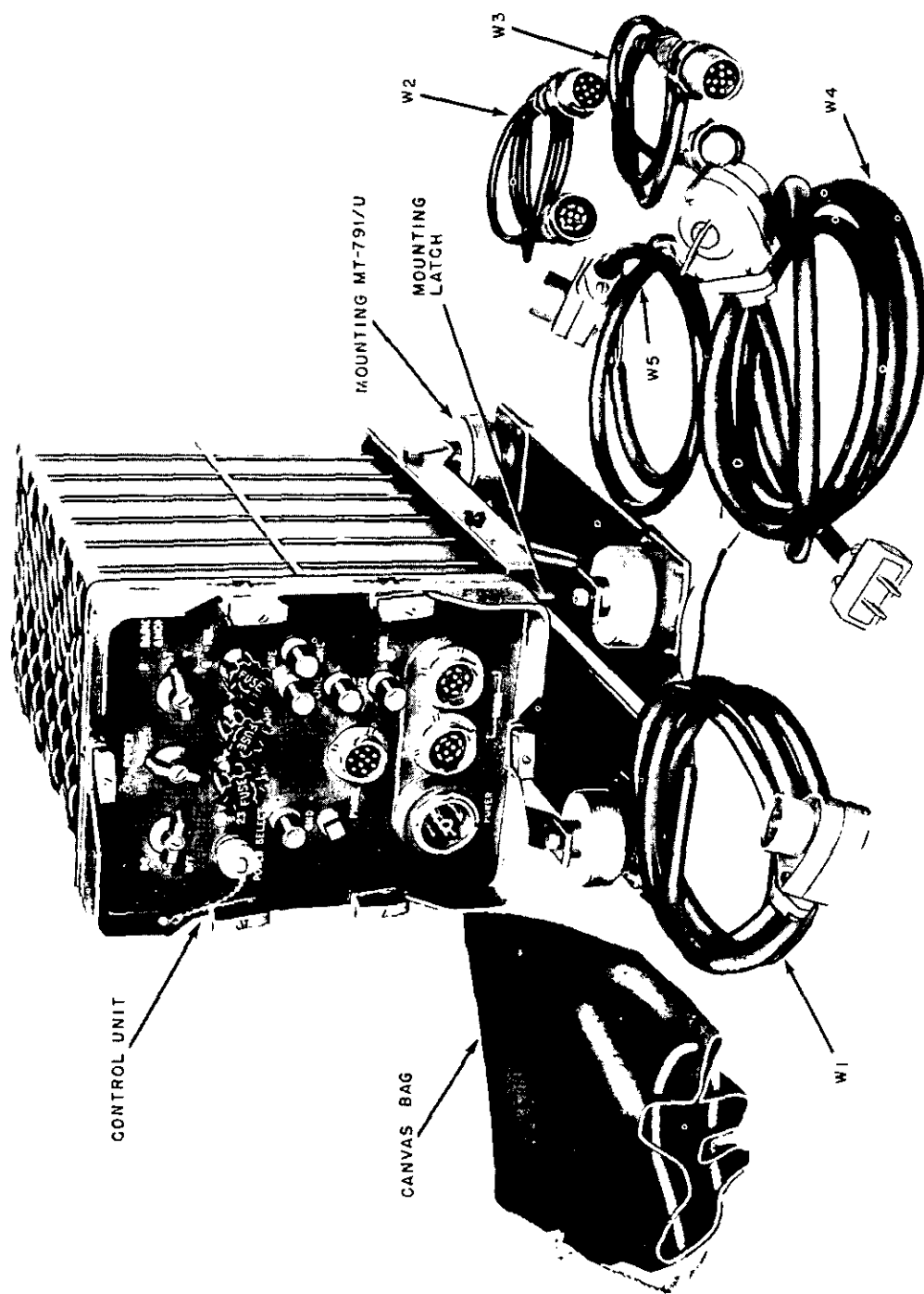


Figure 60. Radio set control AN/GSA-7.

- (e) Battery life expectancy—24 hours.
- (f) Tone generator frequency—3,900 cycles per second.
- (2) Radio set control C-2329/GRA-39 (local control unit):
 - (a) Number of transistors—Seven.
 - (b) Operating voltage—9.0 to 6.6 volts direct current.
 - (c) Power supply—Six batteries BA-30.
 - (d) Battery life expectancy—72 hours.

b. Radio set control AN/GRA-39 can be used for the following types of operation:

- (1) Telephone communication between the remote and local control operators.
- (2) Radio set transmission and reception from the remote control unit.
- (3) Radio set transmission and reception from the local control unit.

c. For additional information, see TM 11-5820-477-12.

168. Radio Set Control AN/GSA-7

Radio set control an/GSA-7 (fig. 50) is a small, lightweight electronic switching device for use in

integrating wire/radio systems. It is also used to interconnect radio transceivers, or transmitters and receivers, with local battery telephone equipment on a push-to-talk basis. Two radio set controls can be used to interconnect two push-to-talk radio sets for retransmission (automatic relay). These controls permit the operator to listen or talk to both ends of the circuit or to signal in either direction. The equipment can be operated from the ground or from a stationary vehicle. Typical systems using the AN/GSA-7 are shown in figure 51.

169. Radio Test Set AN/VRM-1

The radio test set AN/VRM-1 is a compact, lightweight, waterproof test set designed specifically for testing the plug-in modules of the R-442/VRC, RT-246/VRC, and RT-524/VRC (AN/VRC-12 equipments). The equipment is designed on a simple GO and NO GO basis—a glowing green light indicates a serviceable module; a glowing red light, a defective module. The equipment is intended for issue to organizational maintenance personnel. For further details on the AN/VRM-1, see TM 11-6625-496-12.

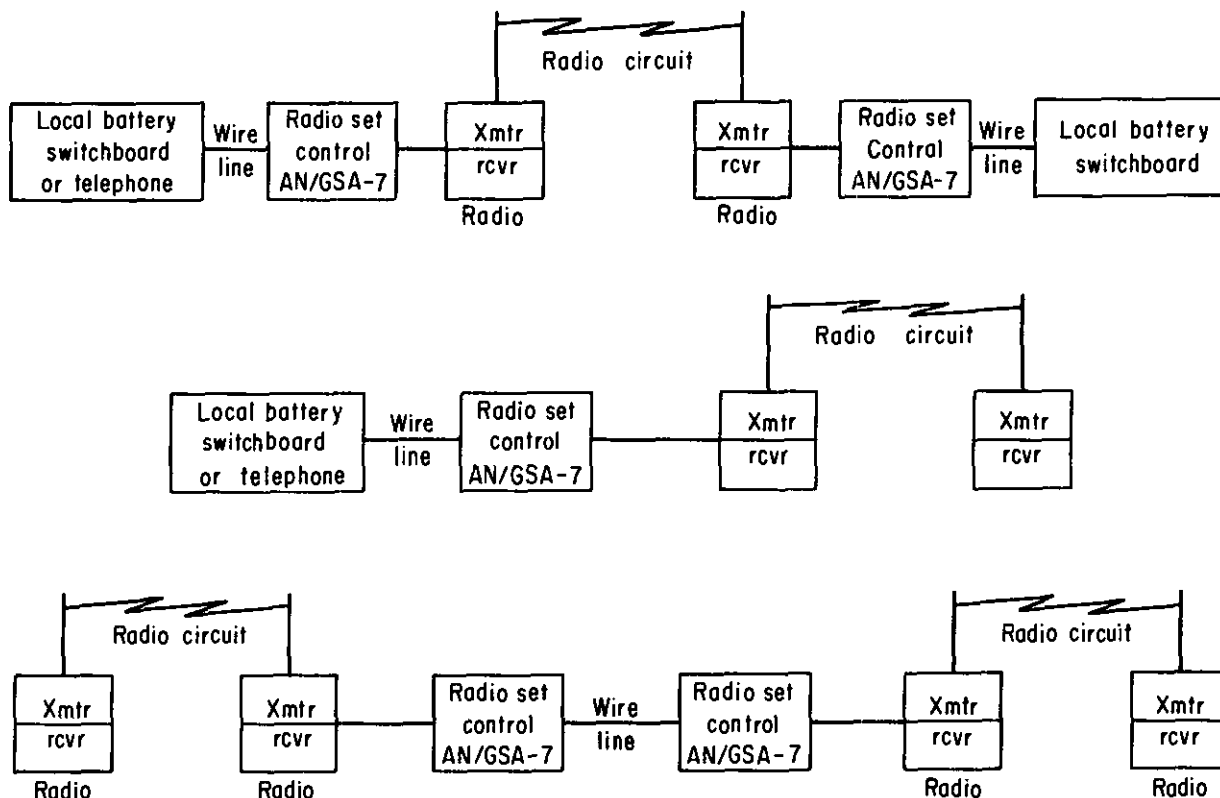


Figure 51. System application of radio set control AN/GSA-7.

170. Antenna Group RC-292

Antenna group RC-292 (fig. 52) is a modified ground plane antenna designed to increase the transmission range of FM radio sets operating over a frequency range of 20 to 70 megacycles. The sections of the supporting base raise the antenna 30 feet above the surface of the ground, increasing the line-of-sight distance to the horizon. The vertical element above the mast base is the antenna, and the three ground plane elements are installed at a 142° angle to the antenna to act as the counterpoise. The antenna group is connected to the radio set by a 68-foot coaxial cable. This equipment provides a radiation pattern that is omnidirectional in the horizontal plane. The length of the antenna and ground plane elements must be preadjusted to the desired frequency range as shown in chart I.

171. Field Expedients

a. *Whip Antennas.* When a whip antenna is mounted on a vehicle, the mass of the vehicle affects the operation of the antenna. This is particularly true of an antenna mounted on a ¼-ton truck. For example, ¼-ton vehicle with a whip antenna mounted on its left rear will transmit its strongest signal in a line running from the antenna through the right front of the vehicle; an antenna mounted on the right rear will transmit its strongest signal across the left front of the vehicle (fig. 53). A vehicle oriented for best reception is normally in the best position for transmission.

b. *Improvised Antennas.*

- (1) *Improvised elevated antenna.* An elevated antenna (fig. 54) can be constructed from materials readily available in a field artillery unit. The standard vehicular antenna complete with bracket and mast

base may be raised on poles to a desired height. The antenna may be connected to the radio set with standard field wire. The guy lines, with insulators properly installed, can be used as the ground plane or counterpoise.

- (2) *Wave antenna.* The wave antenna (fig. 55), a type of long wire antenna, is easily constructed with field wire and any supports available, such as trees or bushes. This antenna is directional off the terminated end and compares to the RC-292 in its ability to increase transmission range. The terminating resistor makes the antenna nonresonant so that its impedance does not vary with frequency but concentrates the radiated energy in one direction. The value of resistance is not critical, but its power rating should be large enough to handle one-fourth to one-half the total transmitted power.
- (3) *Vertical half-rhombic antenna.* The vertical half-rhombic antenna (fig. 56) is more efficient than a whip antenna and is also directional off the terminated end. This antenna's gain increases with size. When the limiting factor in the size of the antenna is available mast height, a leg length is used as indicated in the formula—

$$L = \frac{H^2 f}{222} + \frac{56}{f}$$

where f is the frequency in megacycles, H is the mast height in meters, and L is the leg length in meters. The example in figure 56 is solved for a mast height of 10 meters and a frequency of 30 megacycles.

Chart I. Antenna and Ground Plane Element Preadjustment

Operating frequency	Antenna sections required	Types of sections used				Ground-plane sections required	Types of ground plane sections			
		AB-21/GR	AB-22/GR	AB-23/GR	AB-24/GR		AB-21/GR	AB-22/GR	AB-23/GR	AB-24/GR
20 mc to 27.9 mc.....	6	3	1	1	1	18	3	1	1	1
27 mc to 38.9 mc.....	4	1	1	1	1	15	2	1	1	1
38 mc to 54.9 mc.....	3	1	1	1	0	12	1	1	1	1
54 mc to 70 mc.....	2	1	1	0	0	9	1	1	1	0

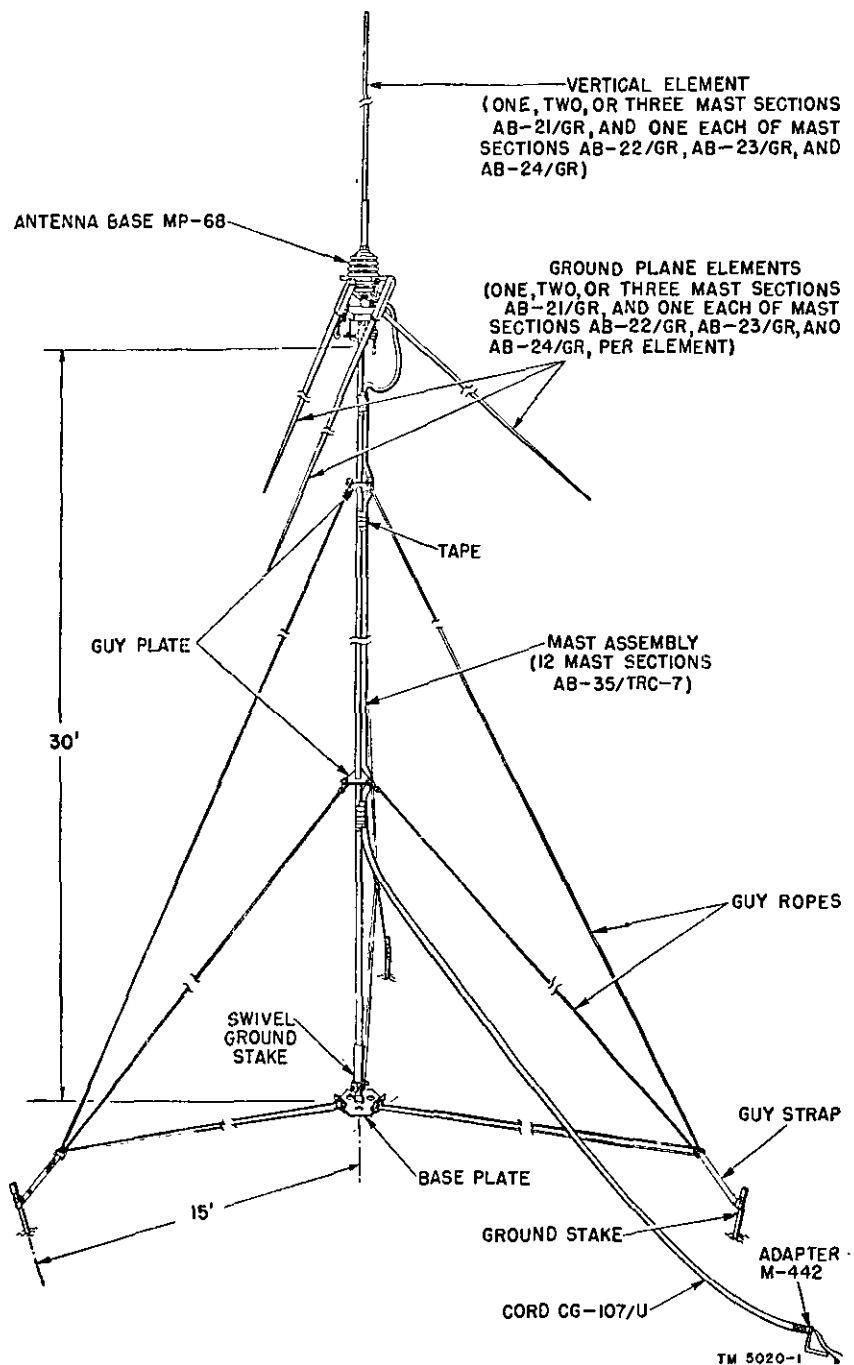


Figure 52. Antenna group, RC-292.

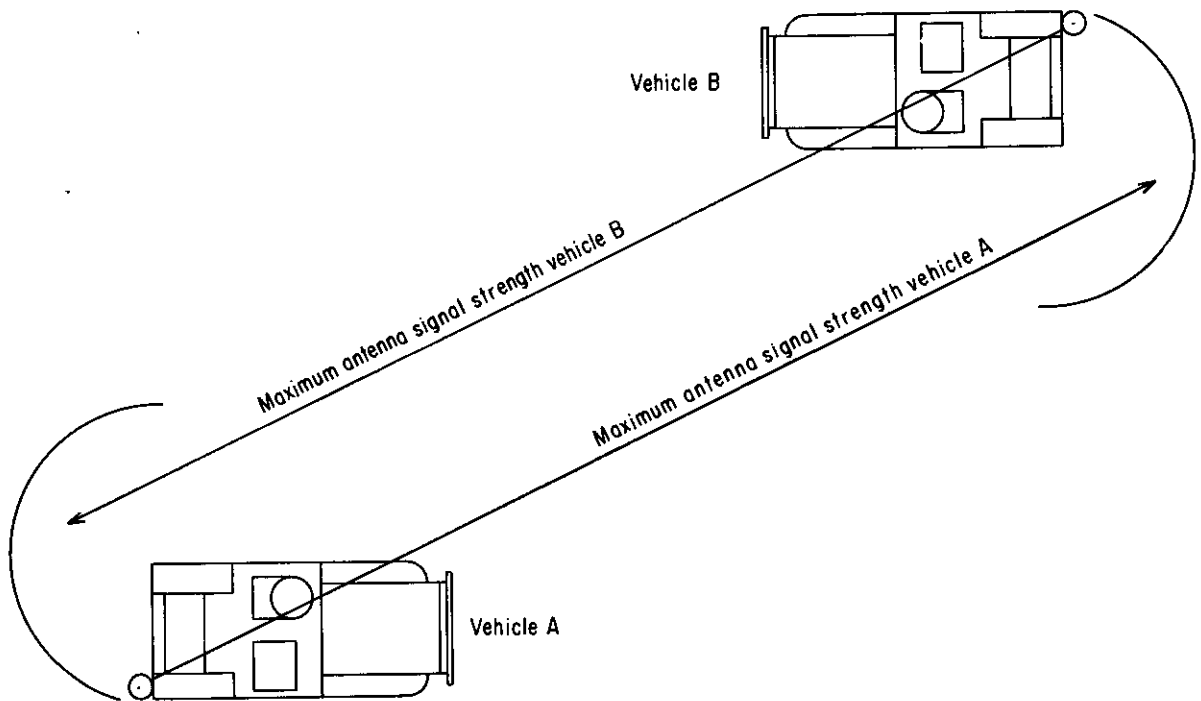


Figure 53. Orientation of vehicle.

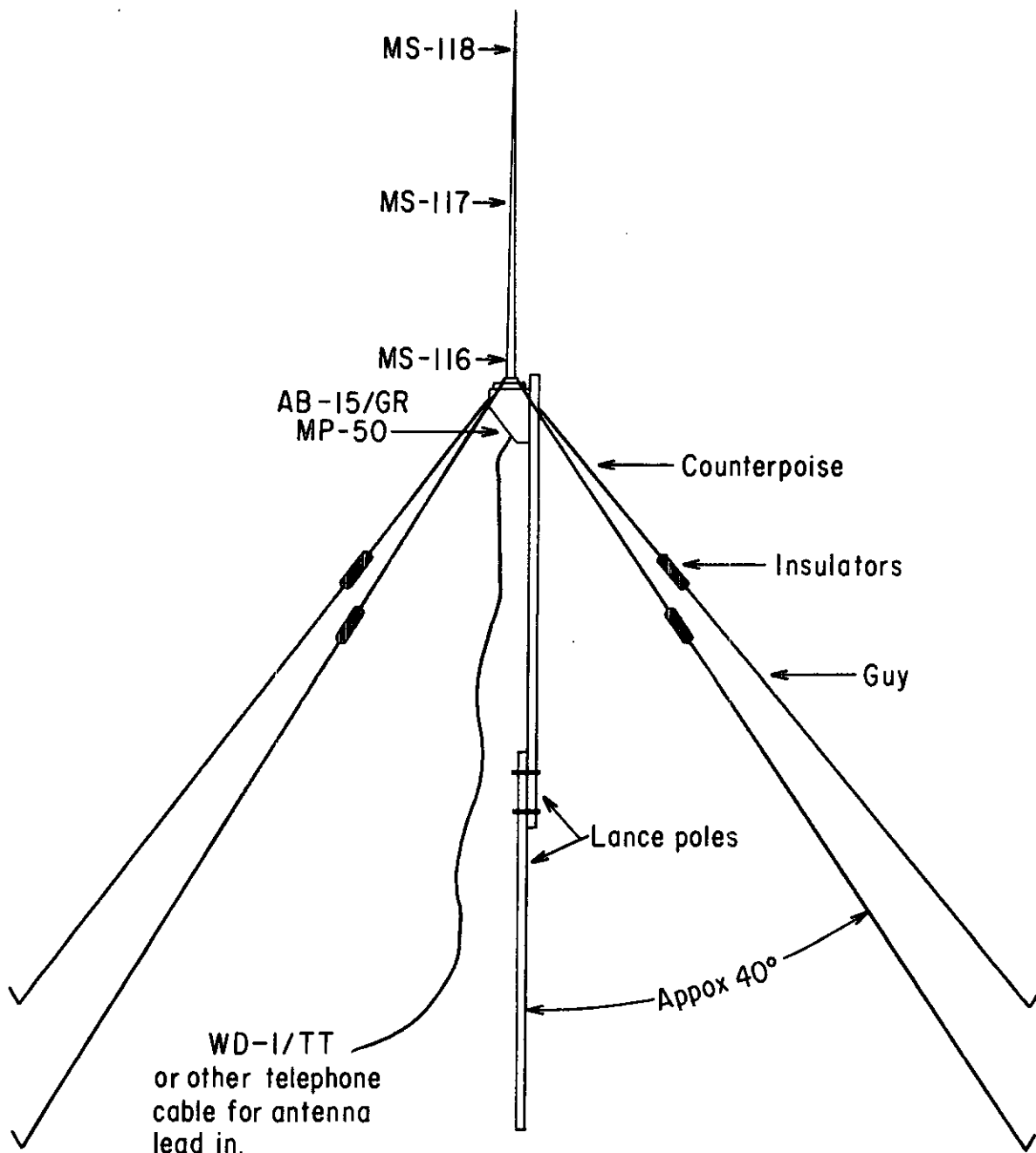


Figure 54. Improvised elevated antenna.

Wave antenna
20 to 80 MC
vertical polarization

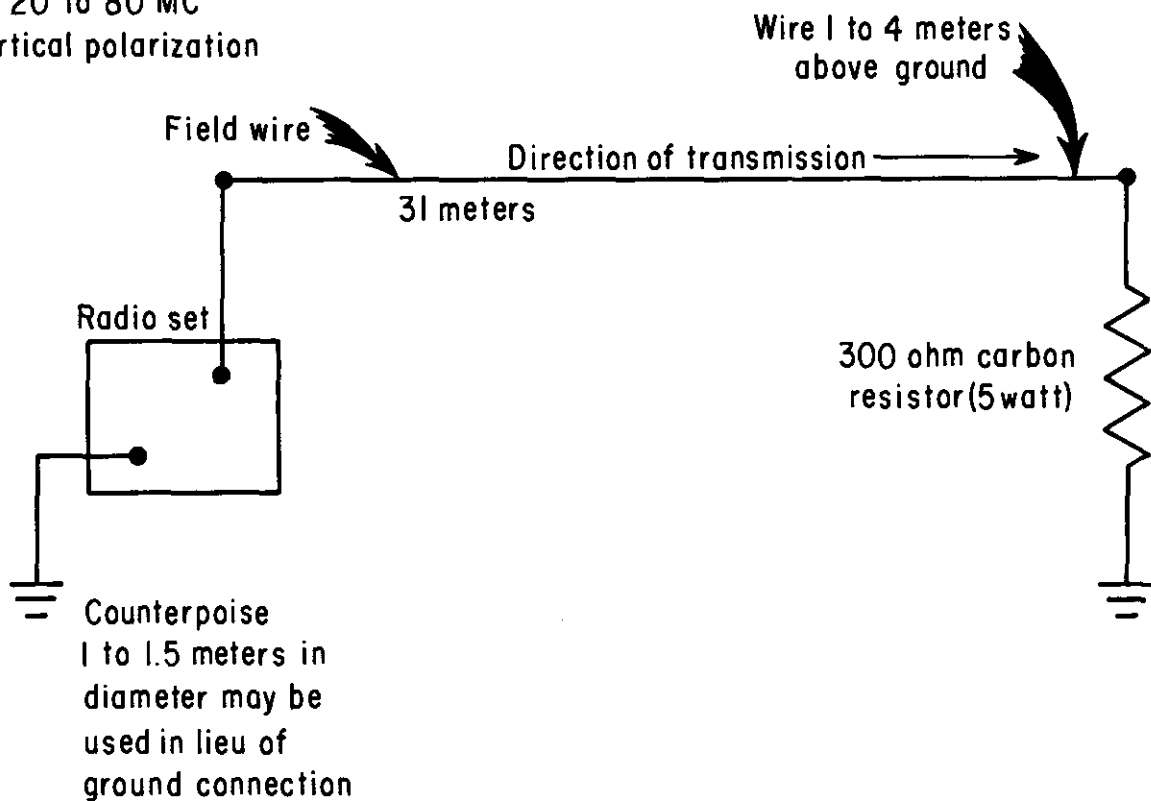


Figure 55. Wave antenna.

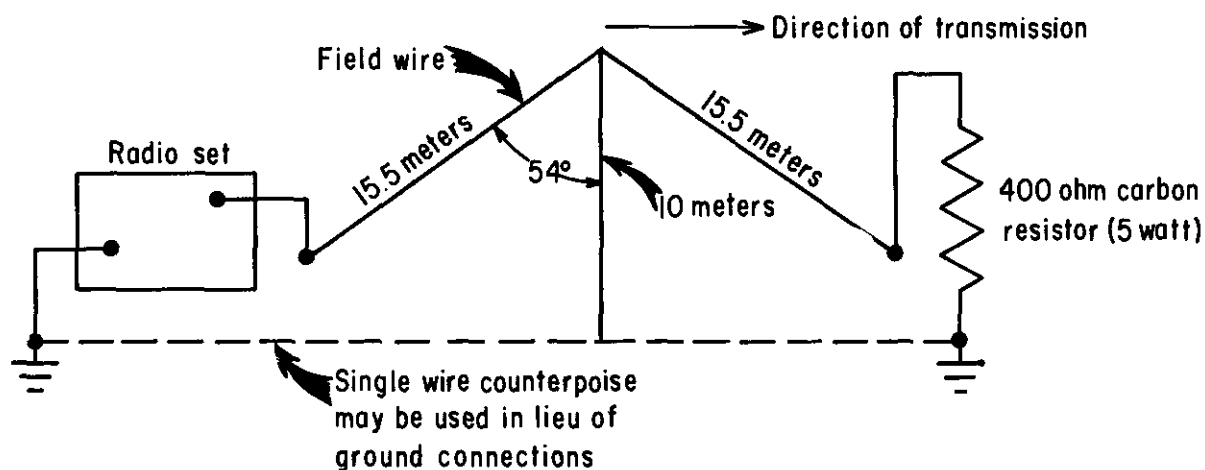


Figure 56. Vertical half-rhombic antenna.

CHAPTER 14

COMMUNICATION SYSTEMS

172. General

A communication system is the result of a communication plan designed to fulfill the requirements of a specific mission. It is based on the assigned mission, the table of organization and equipment (TOE) of a unit, the available communication means, and the principles of communication. A prearranged communication plan should be incorporated in the standing operating procedure (SOP) of any artillery unit and must be kept current. Communication systems must be carefully planned, simple, and must be used by a unit during its various training phases. When properly planned, a communication system will eliminate the publication of numerous and detailed signal orders and instructions and will increase the efficiency of the system and reduce the reaction time of the unit. Such a system will include wire and radio facilities.

173. Wire System

The extent of a unit's wire system will depend on the length of time a unit remains in a position. Priority is always given to the installation of wire circuits necessary for conduct of fire. A wire system is continually improved by installing duplicate lines over alternate routes, constructing overhead wire crossings, cabling, multiple lines, and rerouting lines around exposed points in the system.

174. Radio Nets

Two or more radios (stations) operating together on a common frequency constitutes a radio net. When several stations are operating in a net, the station representing the senior commander, or another designated station, is the net control station (NCS). According to their use, radio nets are divided into two types—

a. Internal Nets. Internal radio nets are those nets required within a unit and through which a commander can control the elements of his immediate command.

b. External Nets. External radio nets are those nets through which a commander can communicate with elements outside his immediate command.

175. Communication Requirements

The communication requirements for artillery units are based on the organization and the mission of each unit. The communication system of a unit is designed to meet the internal and external requirements of these units.

a. Internal Requirements. The internal communication requirements include facilities for—

- (1) Tactical and administrative control and supervision.
- (2) Fire control.
- (3) Fire direction.
- (4) Collection, exchange and dissemination of information and intelligence.
- (5) Dissemination of warnings.
- (6) Dissemination of meteorological data.
- (7) Coordination of survey.

b. External Requirements. The external communication requirements include facilities for—

- (1) Tactical and administrative control and supervision.
- (2) Receipt of fire missions.
- (3) Requesting additional fire support.
- (4) Coordination of fire support.
- (5) Collection, exchange and dissemination of information and intelligence.
- (6) Receipt of warnings.
- (7) Receipt of accurate time.
- (8) Receipt of meteorological data.
- (9) Coordination of survey.
- (10) Coordination of air traffic.
- (11) Communication with supported unit (when applicable).
- (12) Communication with reinforced unit (when applicable).

176. Functions of Radio Nets

Internal and external radio nets are also designated according to their specific functions. Since the

internal and external requirements of the various artillery units vary, not all artillery units will require all the nets listed. The radio nets may be frequency modulated (FM) or amplitude modulated (AM) nets. They are—

a. Air Defense Intelligence Net AM (AD Intel). The air defense intelligence net, AM, is operated by an army air defense command post (AADCP) of the combat area. This net disseminates intelligence pertaining to airstrikes and other information pertaining to enemy air activities within the area of responsibility. Division artilleries monitor this net.

b. Administrative/Logistics Net, AM, RATT, (Admin/Log). The administrative/logistics net, AM, is used by major combat units, supporting and supply elements to transact administrative and logistical business.

c. Air Net, FM. The air net, FM, is an internal radio net of the Pershing battalion. It provides FM communication between the organic helicopters of the battalion and the aviation section.

d. Air Request Net, AM (Air Req). The air request net, AM, is used by combat units to forward requests for tactical air support directly to a tactical operations center, also to disseminate information and instructions pertaining to airstrikes. The primary means of communication is provided by the tactical Air Force, which provides a direct channel from the forward air controller to the direct support center at corps.

e. Air Traffic Regulation Net, UHF (Air Traf Reg). The air traffic regulation net, UHF, is operated at corps and army flight operations center (FOC) to coordinate the operations of army aircraft with the army air defense command post, which in turn coordinates with the air force. The primary means used by the FOC to effect such coordination are sole-user circuits in the army area system, using teletype facilities. As an alternate means and also to provide UHF equipment to communicate with other army aircraft in the area, the aircraft and the aviation section are equipped with UHF radio sets, which operate in an air traffic regulation net.

f. CG/Command Net, FM (CG Comd). The CG/command net, FM, provides a direct channel of communication between a division commander and all commanders of major units operating directly under division control. Other uses of this net are governed by the desires of the respective division commanders. This net will not be used by subordinate commanders for lateral communication, unless specifically authorized to do so. An airborne relay station may be utilized in this net, if required.

g. Command Net, AM, RATT (Comd). The command net, AM, provides secure radio-teletypewriter communications for transmission of orders and for tactical control and administrative supervision. This net is normally used at army and corps level to communicate with their organic artillery.

h. Command/Fire Direction Net, FM (CF). The command/fire direction net, FM, provides communication with elements of the staff, airborne aircraft, and subordinate units that are within range of FM equipment for tactical control, administrative supervision, and the exchange of information and intelligence. This net will also be used for fire missions when necessary.

i. Command/Fire Direction Net, AM, RATT (CF). The command/fire direction net, AM provides secure radio teletypewriter communication for tactical control and administrative supervision of subordinate units, dissemination of meteorological data, and for control of nuclear fire missions. It is also used for exchange of information and intelligence.

j. Command/Intelligence Net, FM (CI). The command/intelligence net, FM is used by a commander for communication with his staff, airborne aircraft, and subordinate elements that are within the range capability of the equipment.

k. Command/Intelligence Net, AM, RATT (CI). The command/intelligence net, AM, provides a secure radio teletypewriter communication link between the units operating in this net. This net is used for tactical control, exchange of information and intelligence, and transmission of battlefield information.

l. Command/Light Direction Net, FM (CL). The command/light direction net, FM, is used for tactical and administrative control of a searchlight battery and to receive and process light direction missions. In normal situations, the battery commander may not be within range of all elements of his battery; however, with proper siting of radios and use of proper antennas he should be able to communicate with the platoon commanders, who are able to communicate with their sections.

m. Command/Operation Net, FM, (CO). The command/operation net, FM provides a direct FM radio channel for control, command and administration of a unit. It ties together the commander, the staff, and the various sections of the command that are within FM range.

n. Fire Direction Net, FM (F). The fire direction net, FM is used to process fire missions and for exchange of information and intelligence. Some

artillery units require more than one fire direction net, in which case they are numbered F1, F2, etc.

o. Fire Direction Net, AM, RATT (F). The fire direction net, AM, is used for coordination of artillery fire between artillery echelons and also for requesting additional fire support from a higher artillery headquarters without having to go through regular command channels. It is a secure radio teletypewriter net.

p. Flash Ranging Net, FM, (T). The flash ranging net, FM, is an internal radio net of a target acquisition battery. It is used by the flash ranging platoon to exercise control over subordinate elements and to obtain battlefield information and azimuths to hostile targets from the flash ranging observers.

q. Link-Up Net, AM, RATT. The link-up net, AM is a radio teletypewriter net, in the airborne division which provides communication between division artillery in the objective area and friendly artillery of the link-up force. This net is essential for artillery fire coordination.

r. Liaison Net, AM, (LN). The liaison net, AM, provides communications between the headquarters of a command and its liaison officers. It is used for control of the liaison officers and for exchange of information and intelligence.

s. Meteorological Net, AM (M). The meteorological net, AM, is used for coordination of radio-sonde frequencies and time schedules. This net is also used for broadcasting meteorological data on a pre-arranged time schedule. Artillery units normally receive meteorological data from division artillery, corps artillery, or field artillery group by radio teletypewriter over a command/fire direction net, AM, but they may also obtain this data direct by monitoring this meteorological net, whose net control station belongs to the target acquisition battalion of corps artillery.

t. Operation/Intelligence Net, AM, RATT, (Op/Intel). The operation/intelligence net, AM, is an internal net of a division. It is used by the division artillery to receive commands and operation orders from the division. In addition, this net provides a secure radio teletypewriter link between the division artillery and the major combat elements of the division. This net also is used for the exchange of information and intelligence with the division.

u. Sound Ranging Net, FM, (R). The sound ranging net, FM, is an internal radio net of a target acquisition battery. It is used by the sound ranging platoon to exercise control over subordinate ele-

ments and to obtain battlefield information from its sound ranging observers.

v. Spot Report Receiver System, UHF. The spot report receiver system, UHF, is an air force net, used to furnish instantaneous and fragmentary reports by pilots on the results of airstrikes and observations. This net is used by fighter planes and reconnaissance planes. Interested army units and installations can monitor this net to receive such information directly and without delay.

w. Survey Channel, FM (S). The survey channel, FM, may be allocated by corps artillery thereby reducing the number of frequencies required. This channel is common to all artillery survey sections within a corps artillery sector and provides local communication within or between these survey sections. Although this channel is commonly referred to as the corps artillery survey net, operation as a coordinated net is neither intended nor feasible. If interference exists between units, normal radio procedure will prevent confusion.

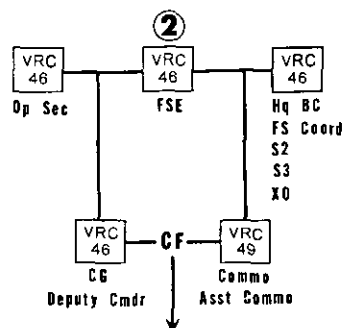
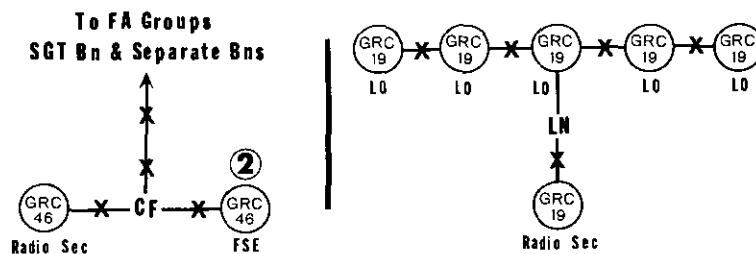
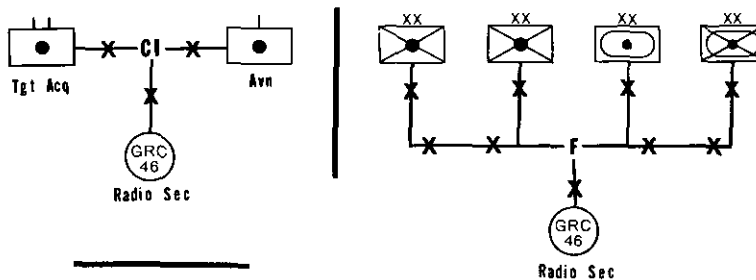
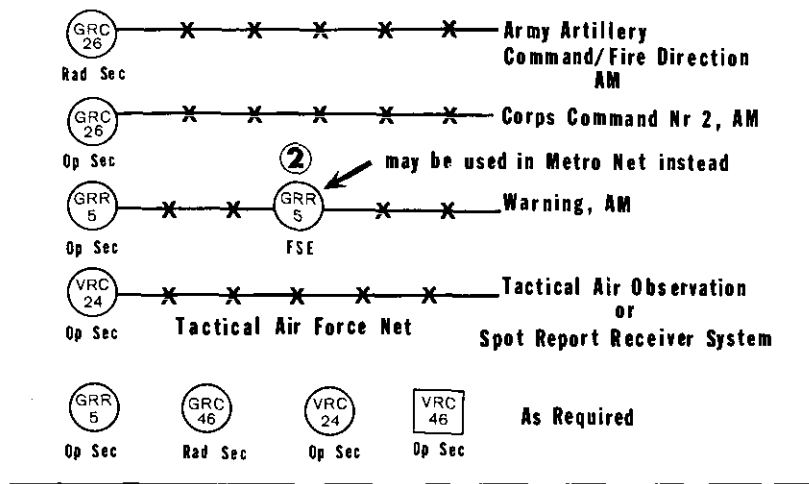
x. Tactical Air Observation Net, UHF, (TAO). The tactical air observation net, UHF, is an air force net. Tactical high performance aircraft and artillery units may communicate over this net for adjusting long-range artillery fire or for surveillance of nuclear fire effect.

y. Time Signal Net, AM. The time signal net, AM, is used to broadcast the official time throughout an entire theater of operations. The theater commander designates one station to broadcast the accurate time in accordance with a planned and published schedule. In addition to being used as the official time for various schedules, it is also available to artillery units that have the capability to conduct astronomical observations.

z. Warning Net, AM (Wng). The warning net, AM, is operated by divisions and other higher echelons. A warning net broadcasts warnings of air alerts; chemical, biological, and radiological attacks; nuclear strikes, fallout patterns, and similar information of an urgent operational nature. Division artillery operates a radio station in the division warning net as it must broadcast warnings pertaining to hostile aircraft received over the air defense intelligence net (*a* above). All other artillery units down to and including batteries monitor this net.

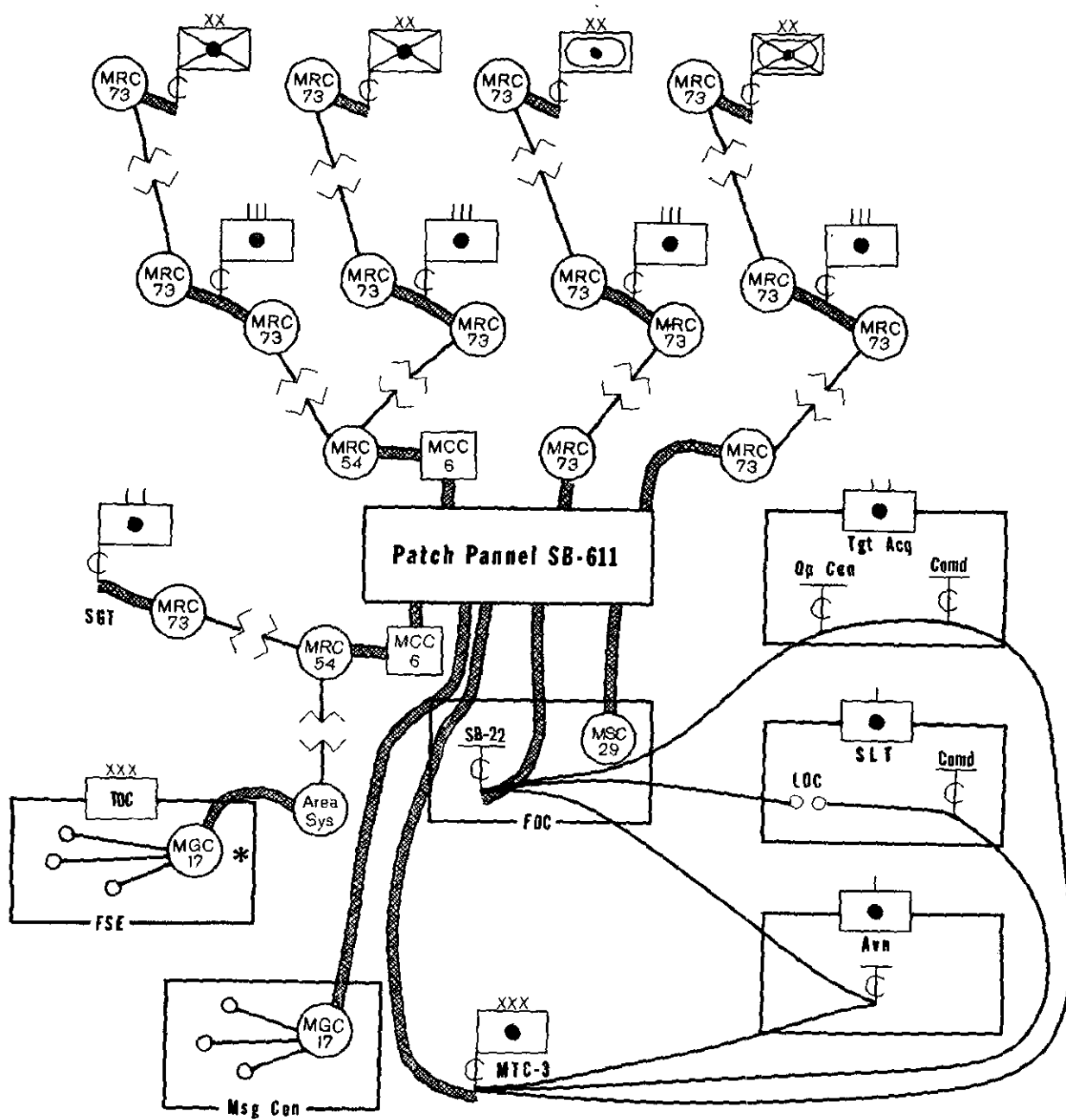
177. Type Wire Systems and Radio Nets

Type wire systems and radio nets are listed by table of organization and equipment (TOE) in figures 57 through 80.



To FA Groups,
Sgt battalion, Separate battalions
Target Acquisition battalions,
Searchlight battery & Aviation battery

Figure 57. External and internal radio nets for TOE 6-501E, corps artillery.



*** Same facilities at alternate TOC**

Figure 58. Wire system for TOE 6-601E, corps artillery.

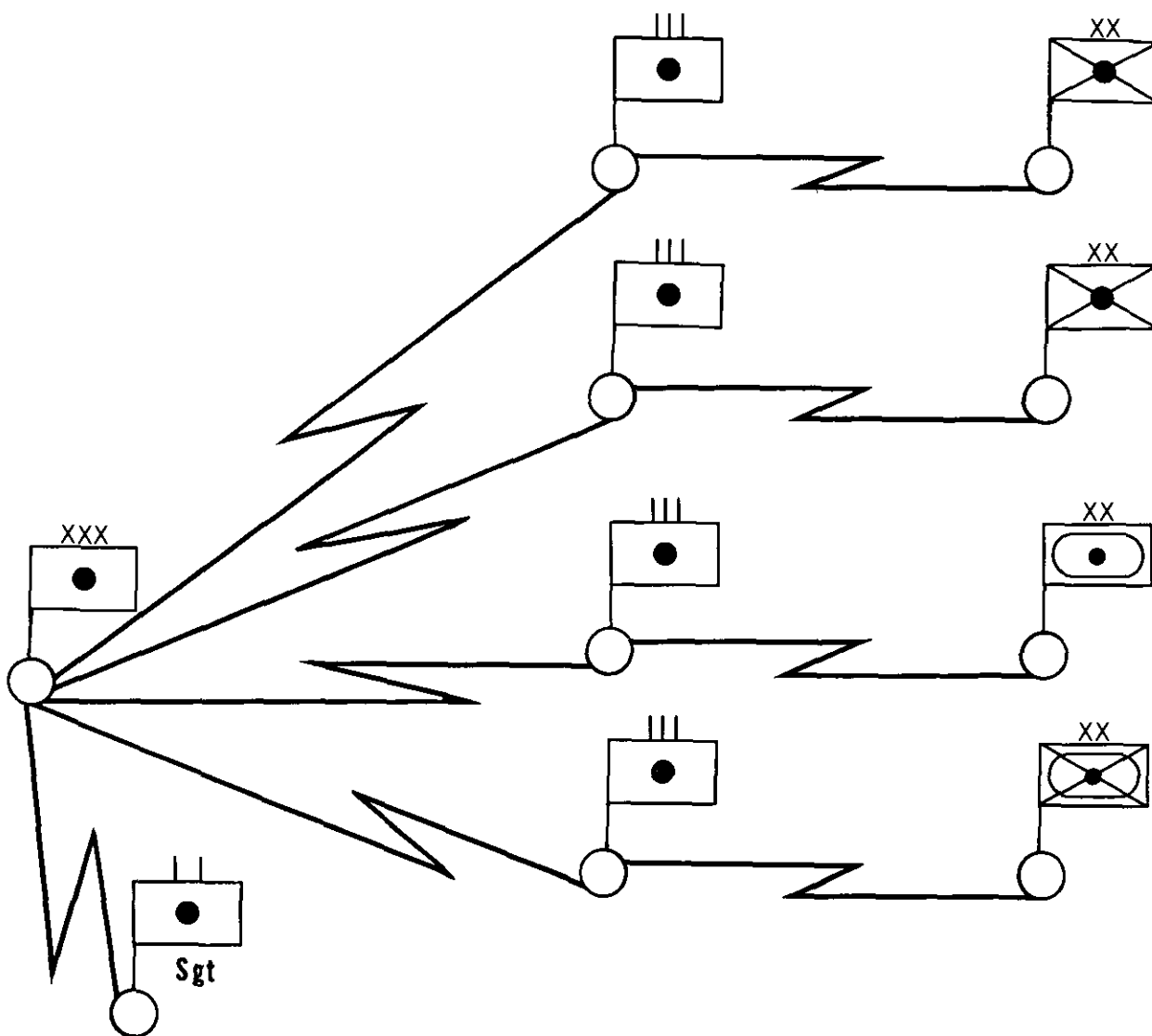


Figure 59. Type radio relay system for corps artillery (provided by corps signal battalion).

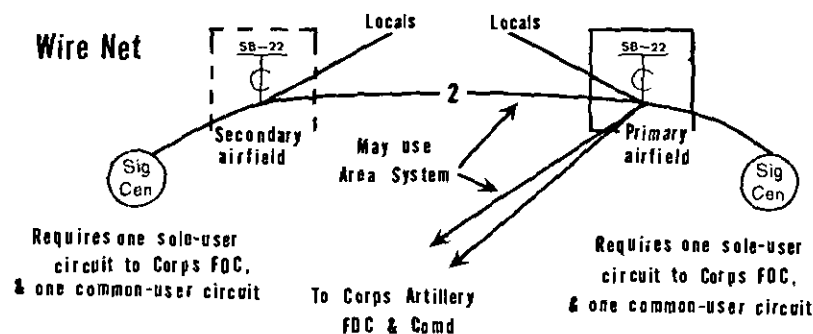
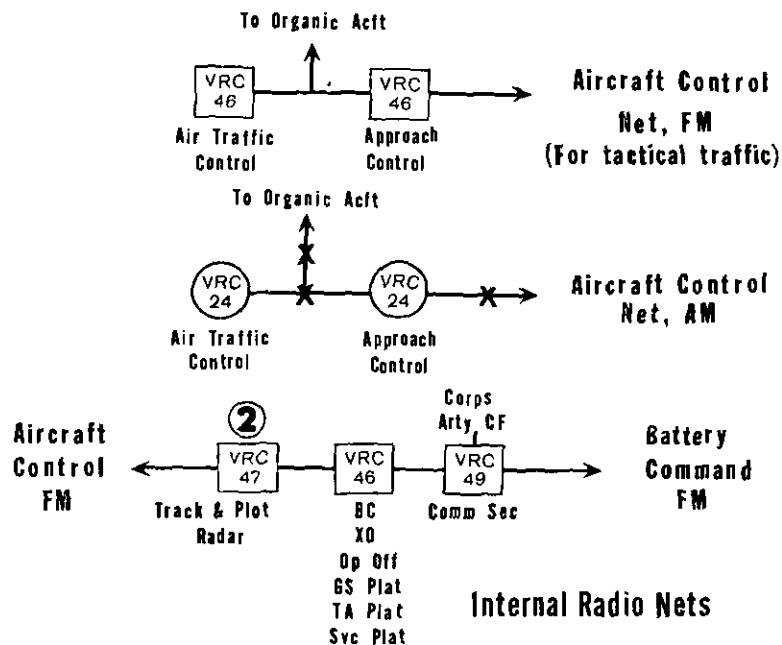
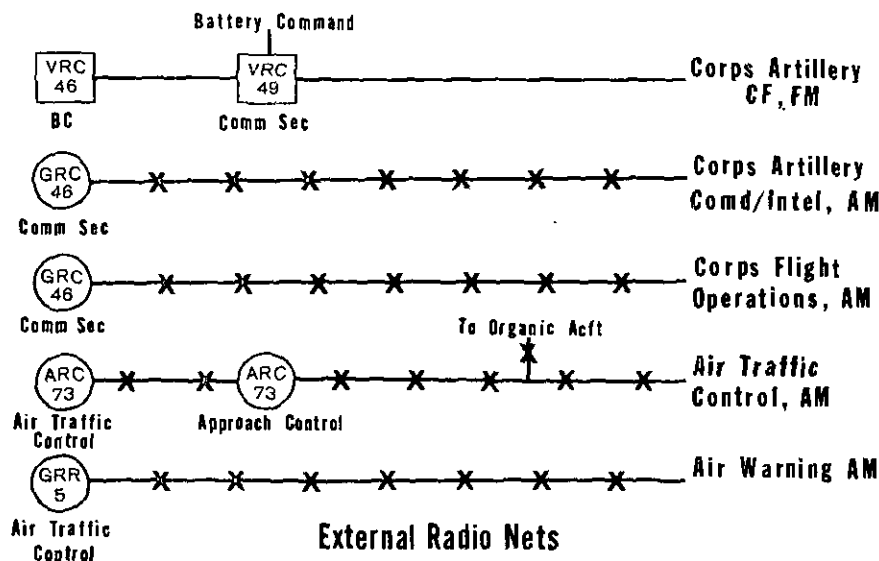


Figure 60. TOE 6-517, corps artillery aviation battery.

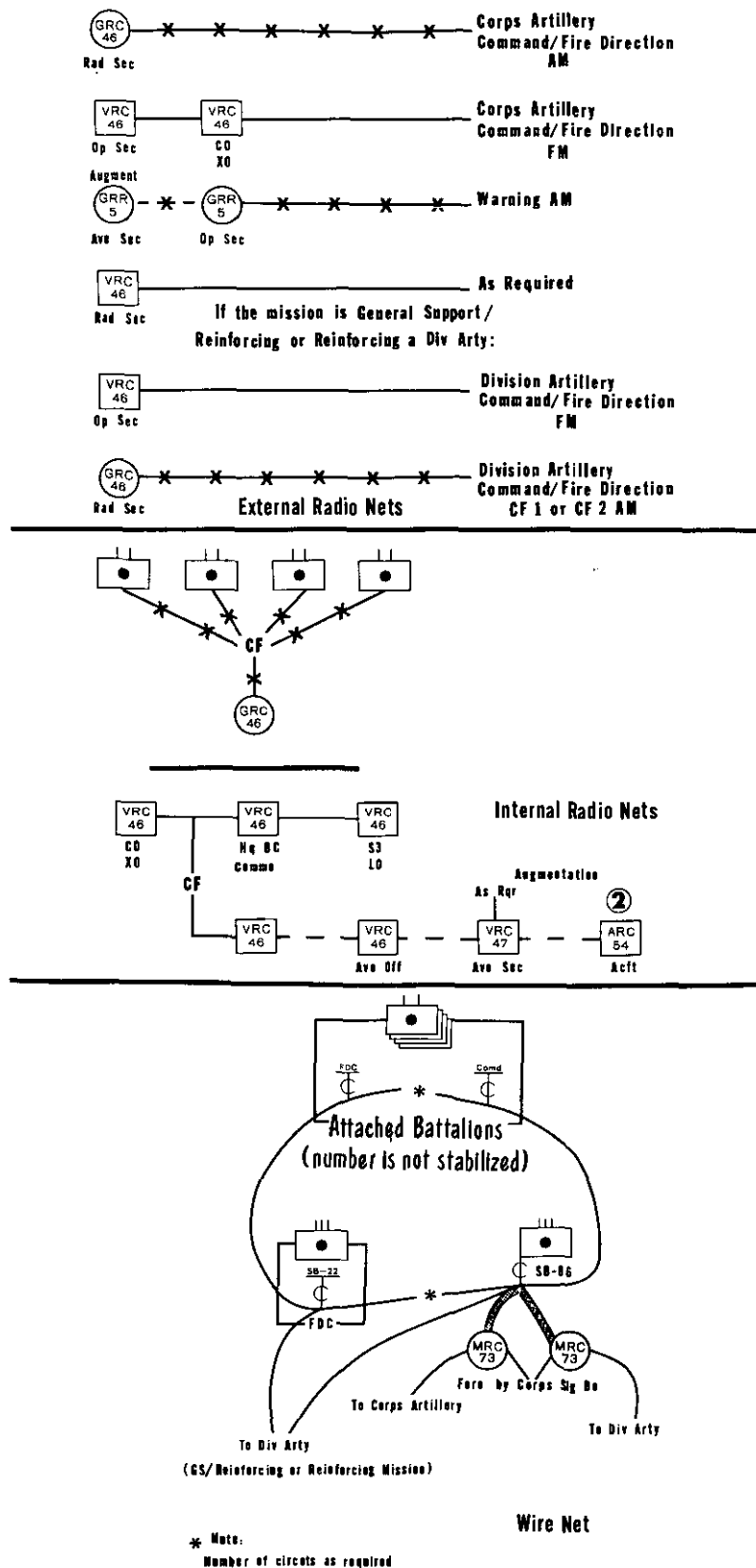


Figure 61. TOE 6-401E, field artillery group.

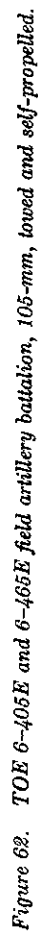


Figure 62. TOE 6-405E and 6-465E field artillery battalion, 105-mm, towed and self-propelled.

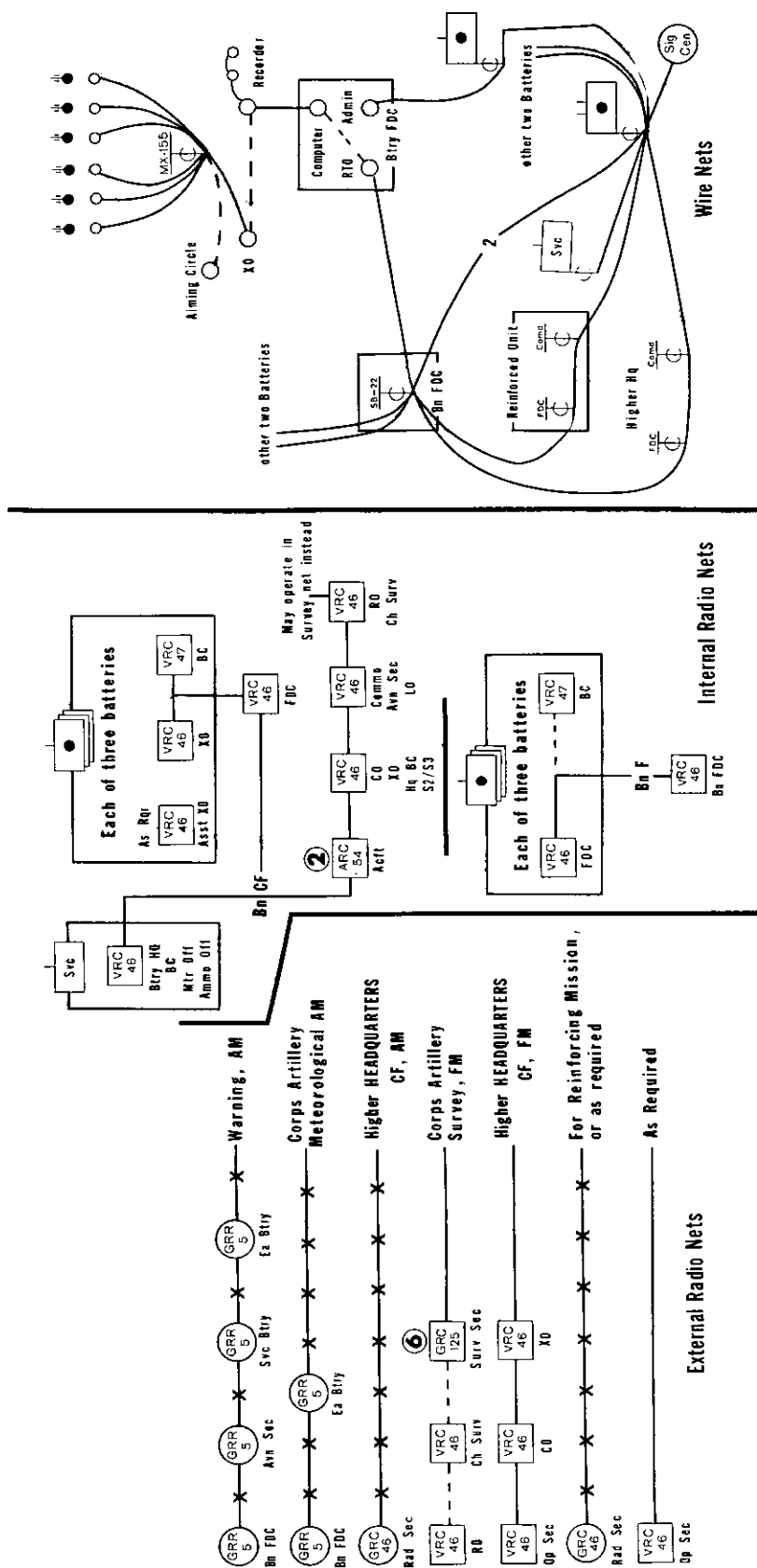


Figure 63. TOE 6-415E, 495D, 435D, 445E, 455E, field artillery battalion, 8-inch, 155-mm, or 175-mm towed and self-propelled.

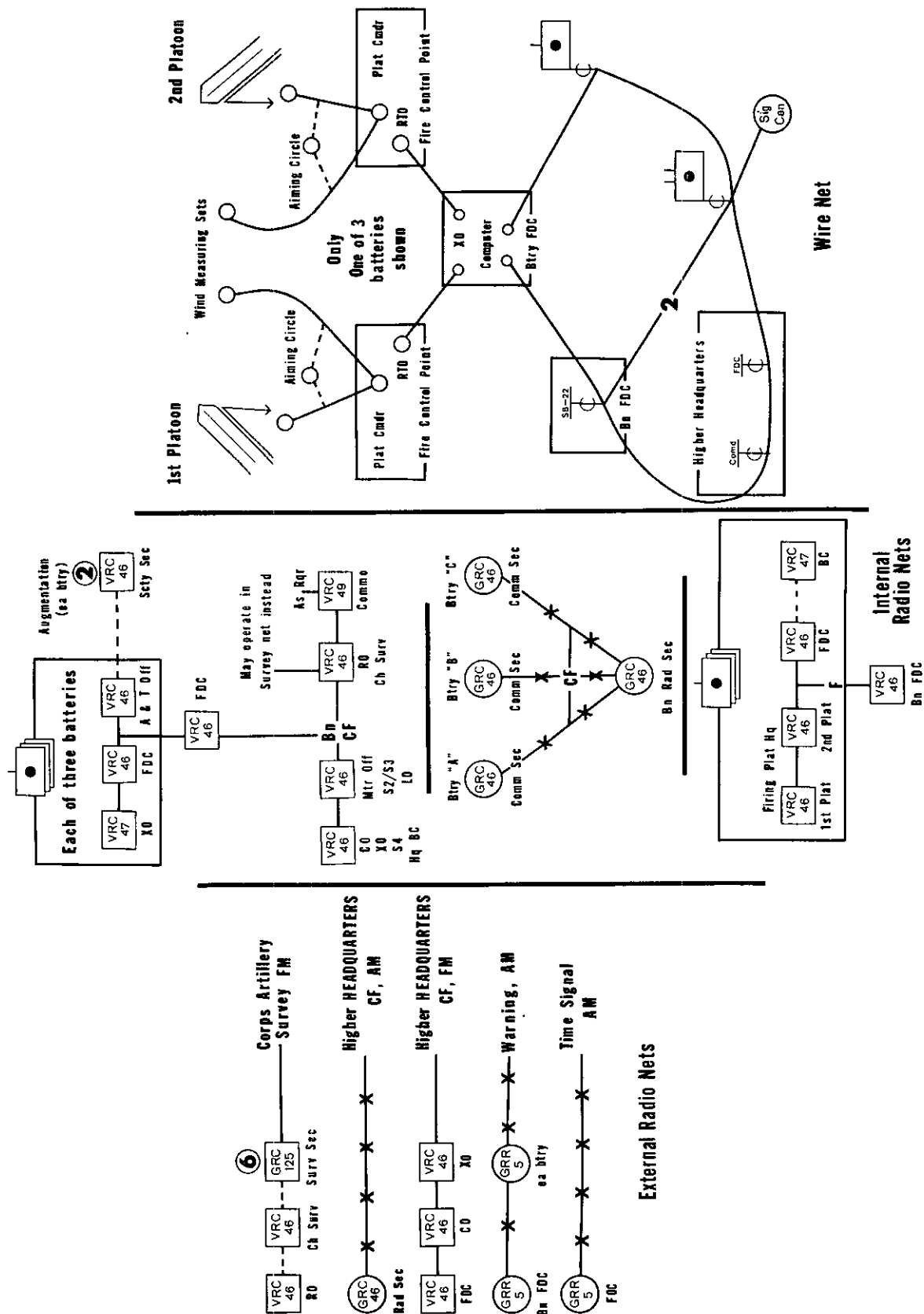
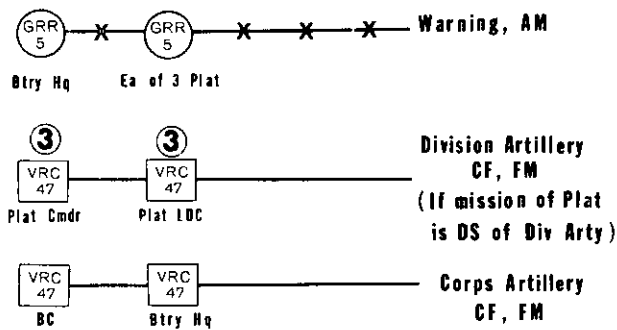
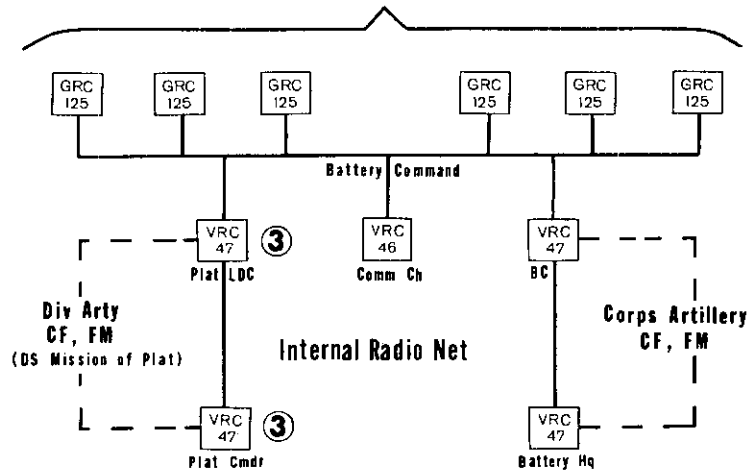


Figure 64. TOE 6-505E and 6-565D, field artillery battalion, Honest John and Little John.

External Radio Net



One of three Platoons



One of 3 Platoons shown (One platoon in DS of Div Arty)

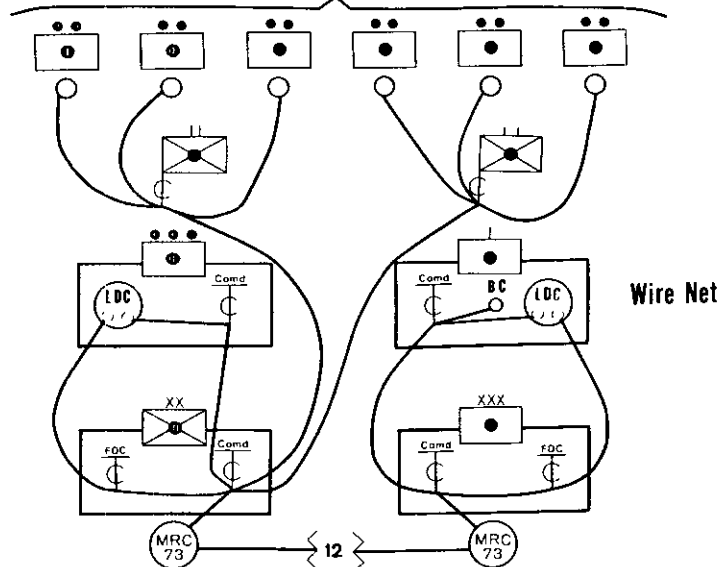


Figure 66. TOE 6-558, field artillery searchlight battery.

All division artilleries operate in net,
Battalions & batteries will monitor as required

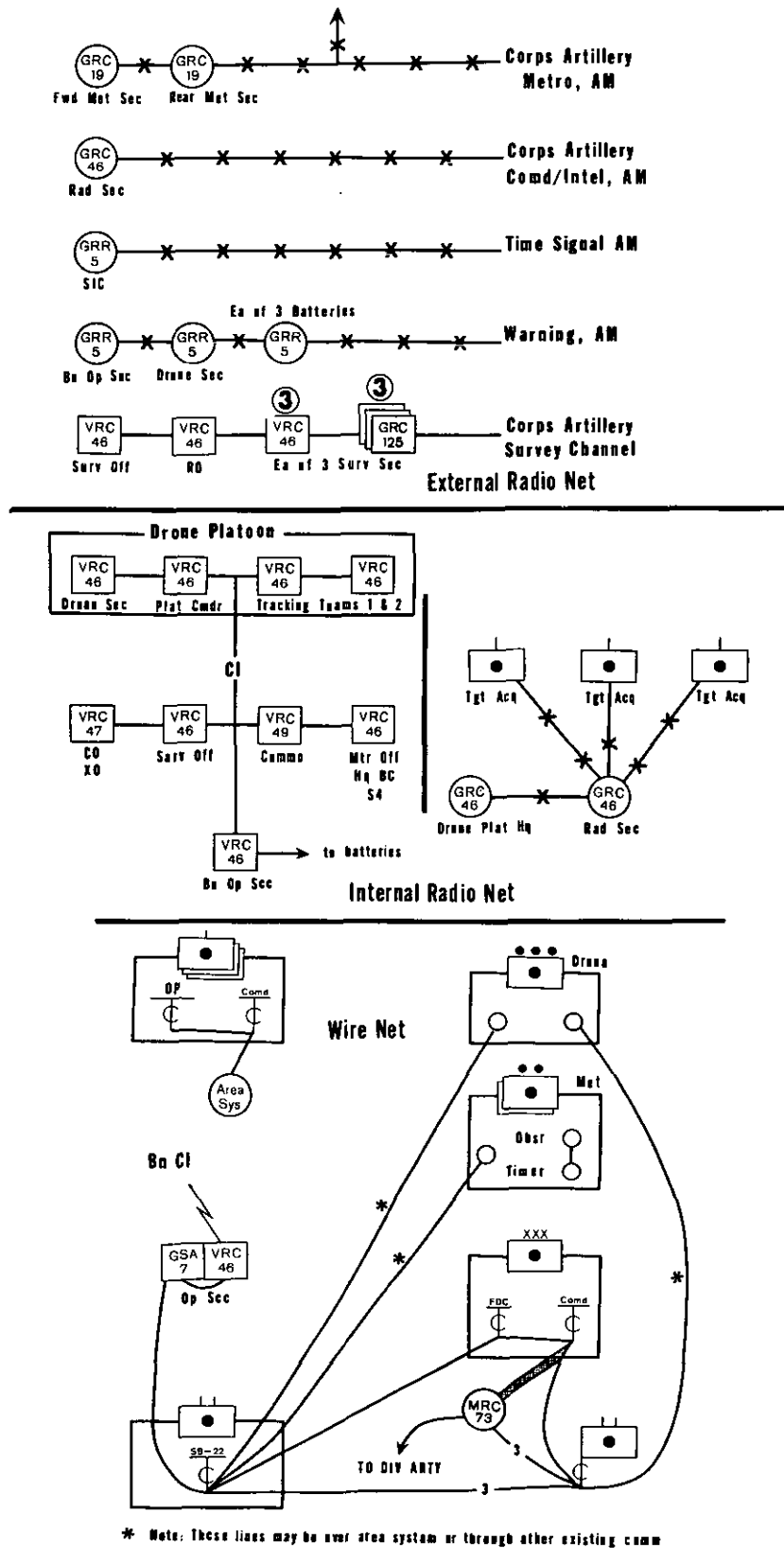


Figure 67. TOE 6-575E, field artillery target acquisition battalion.

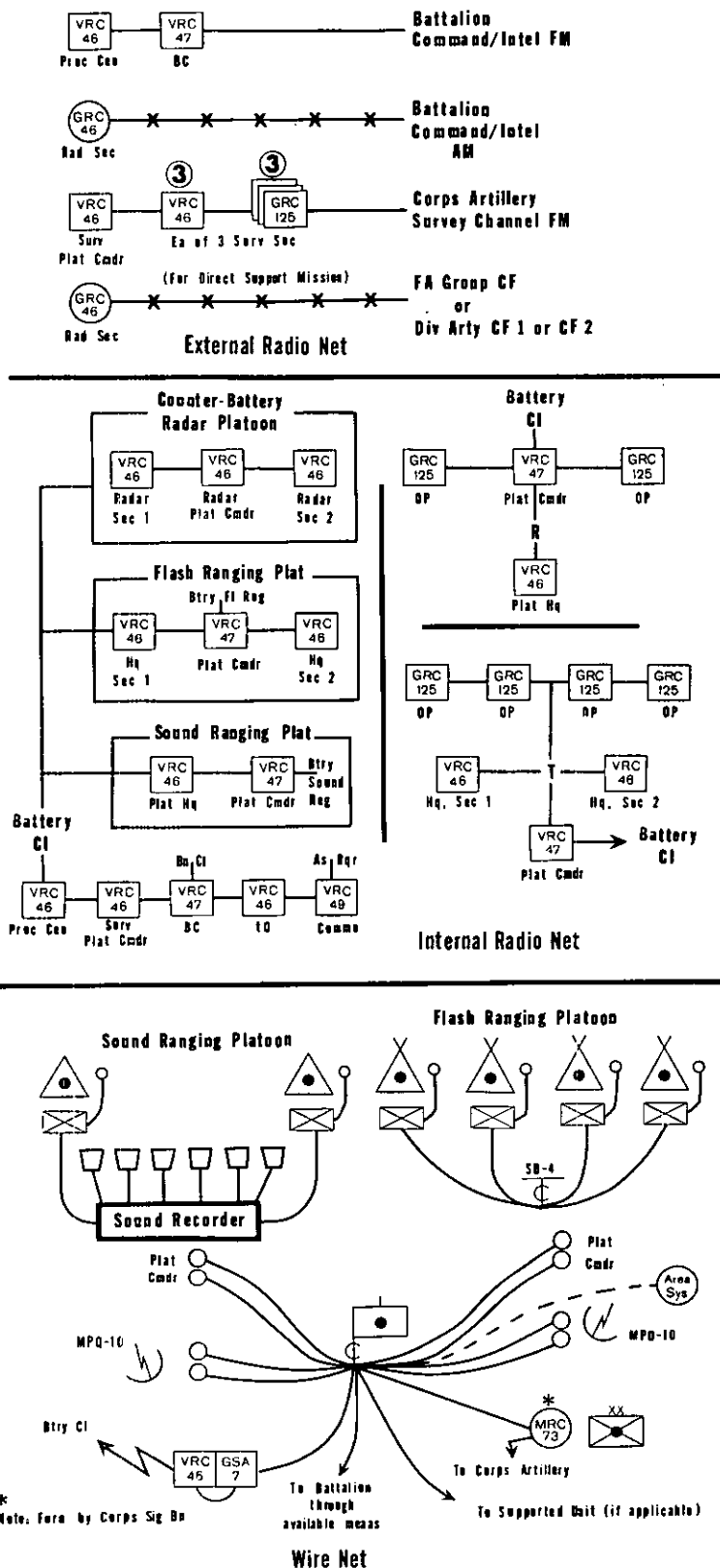


Figure 68. TOE 6-577E, field artillery target acquisition battery.

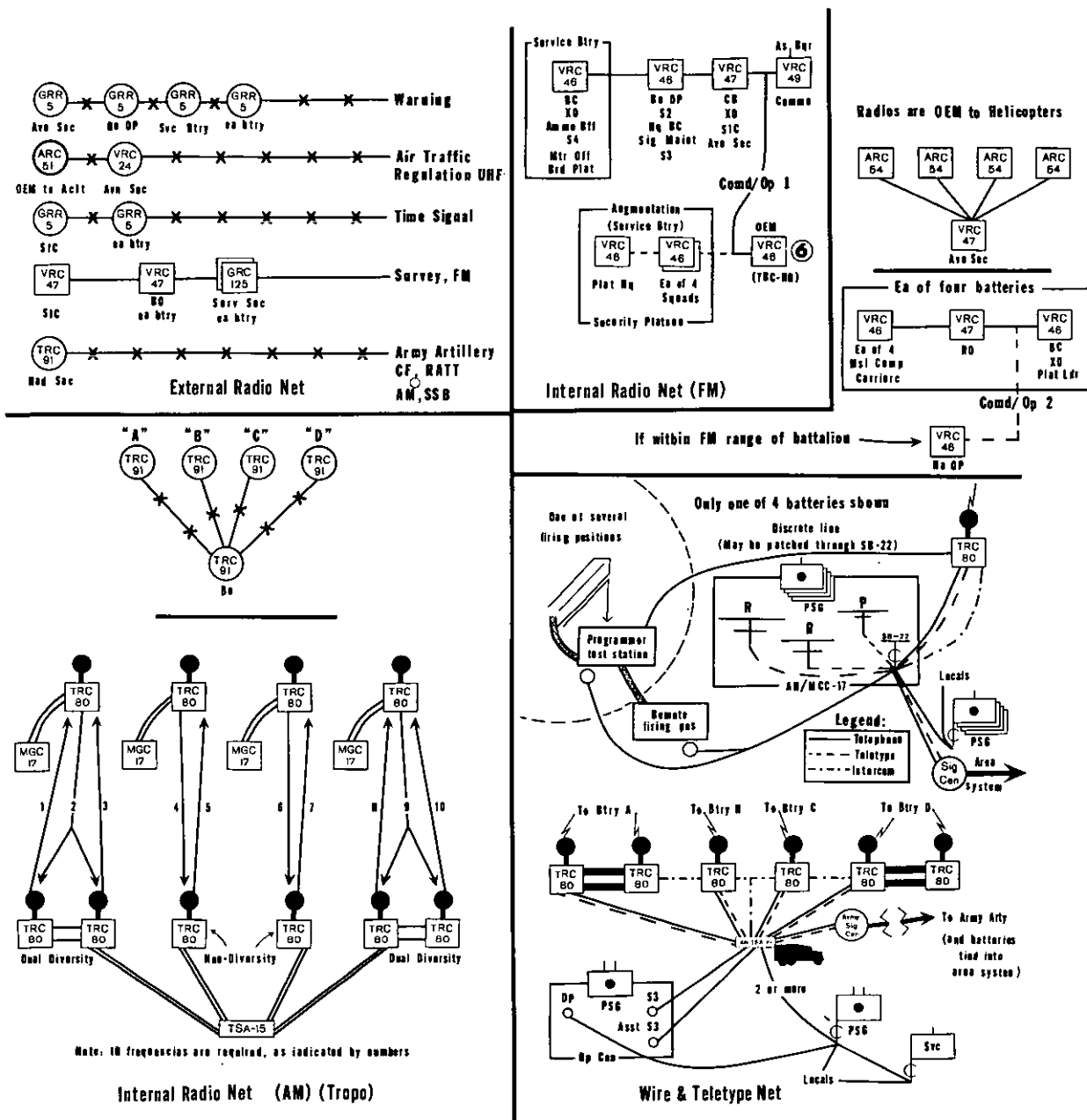


Figure 69. TOE 6-615D, field artillery battalion, Pershing.

Only one of 4 batteries shown

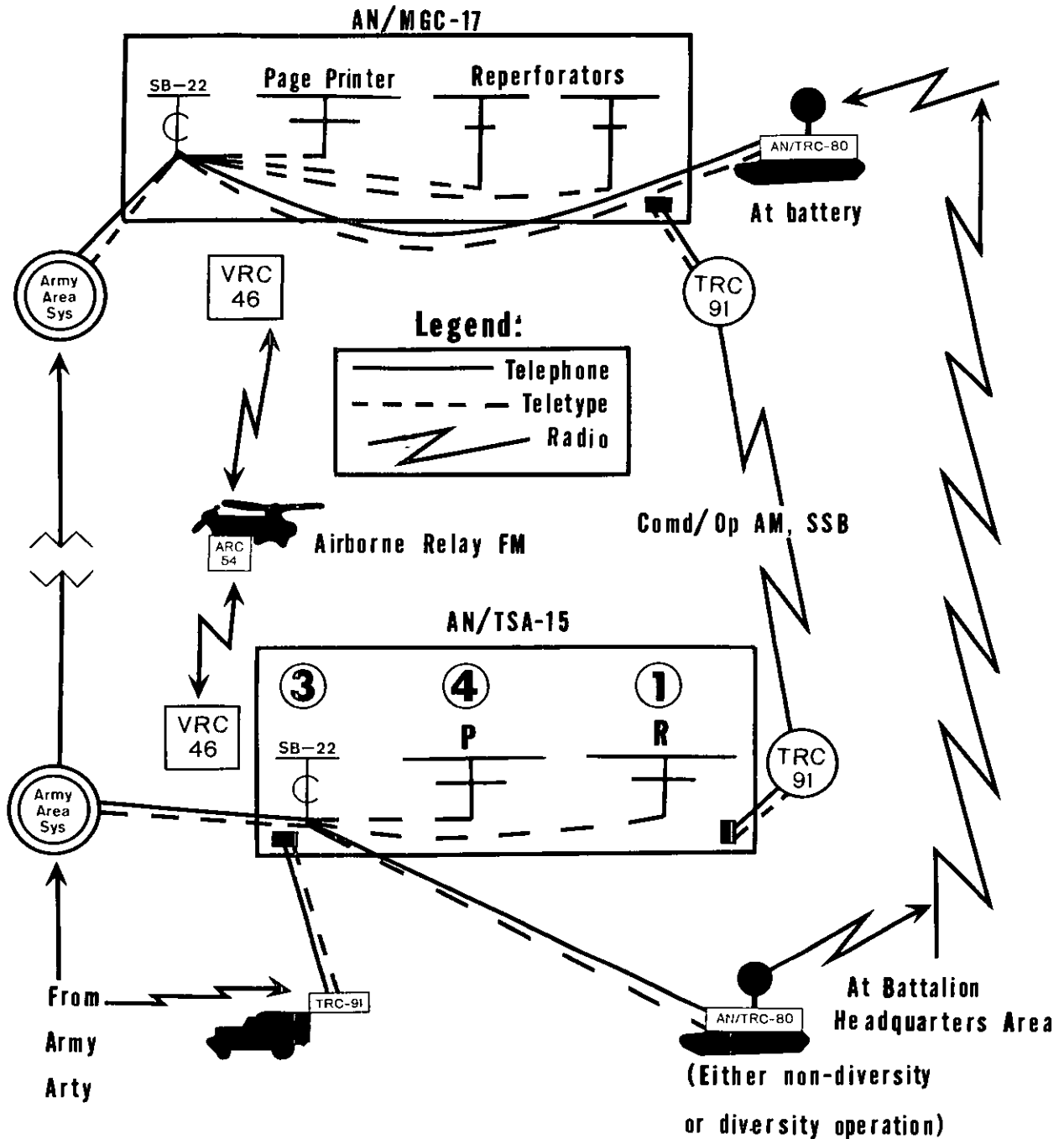


Figure 70. Routing of communications in a Pershing battalion and its batteries.

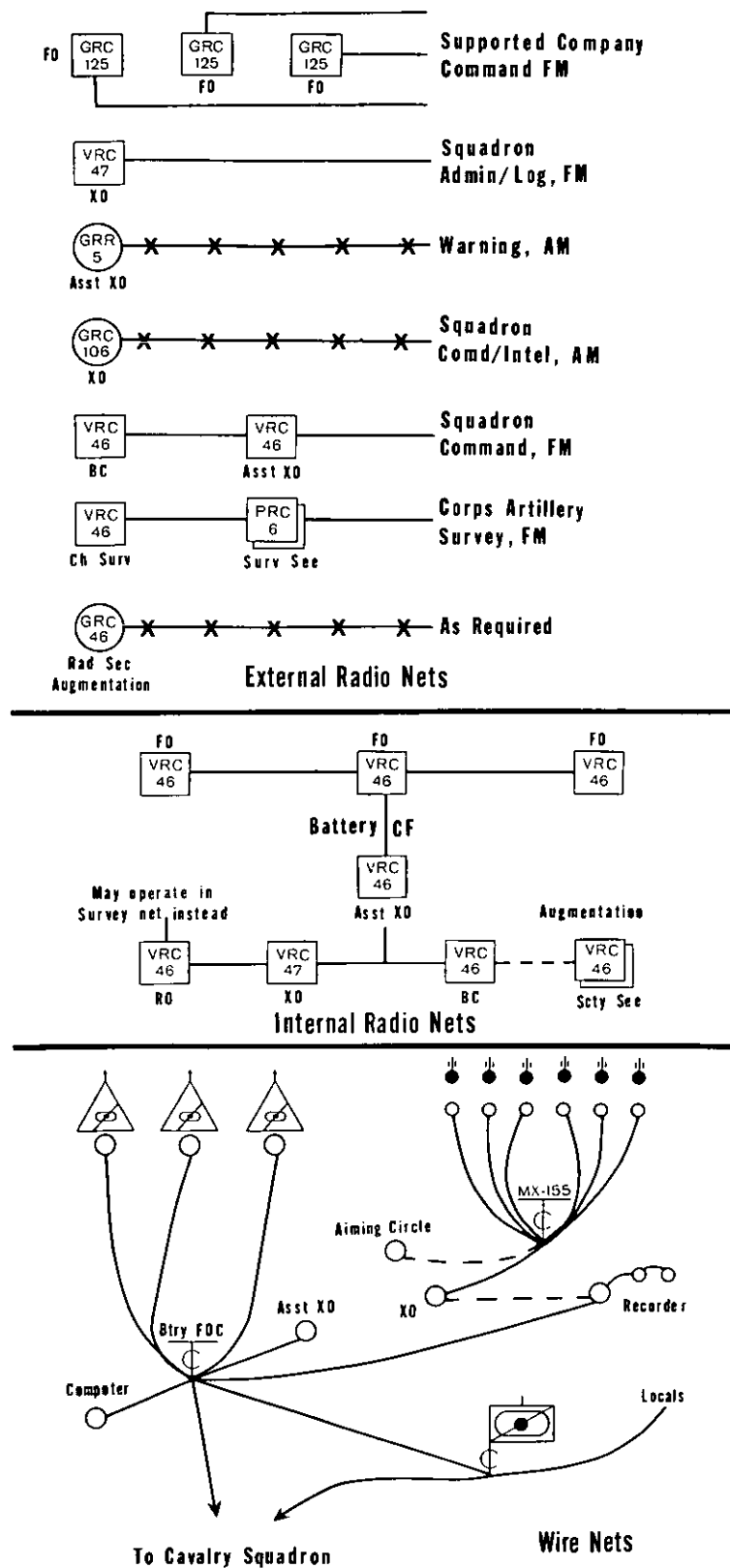


Figure 71. TOE 6-37, field artillery battery, 155-mm, armored cavalry squadron, armored cavalry regiment.

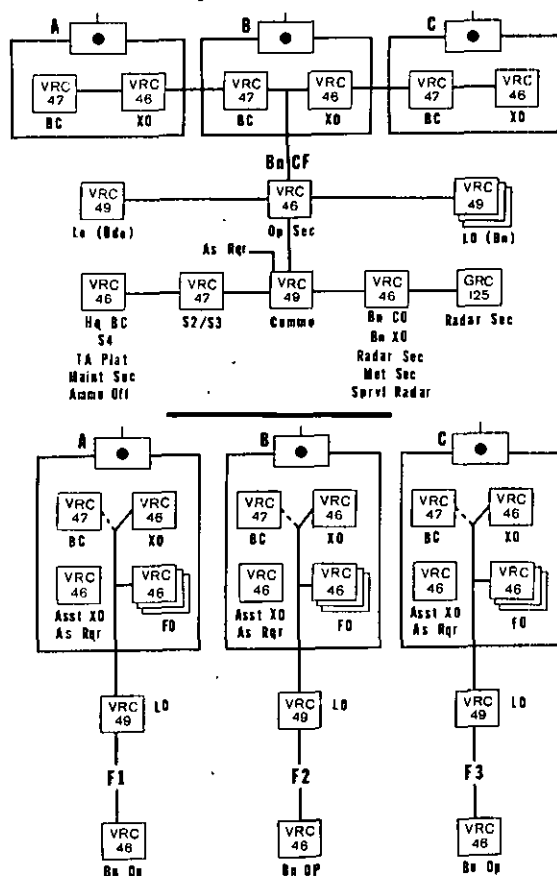
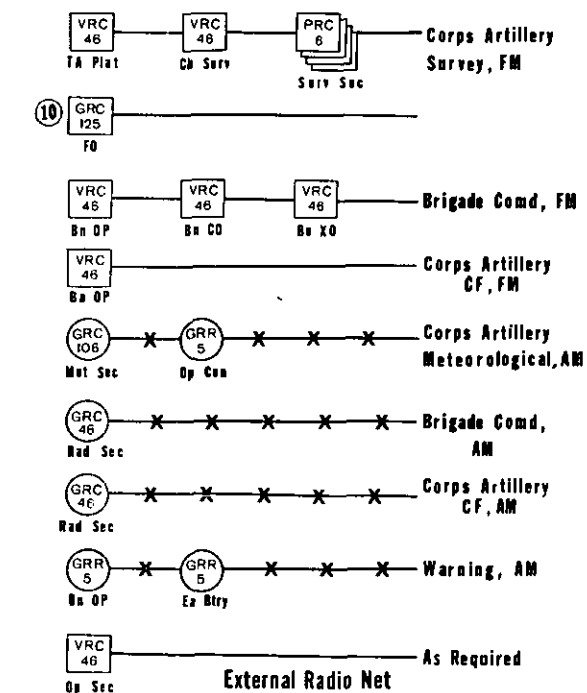
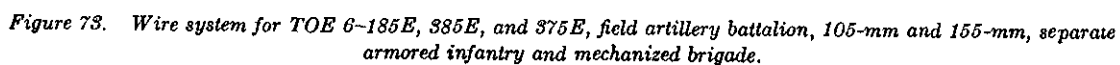


Figure 72. Radio nets for TOE 6-186E, 376E and 385E, field artillery battalion, separate infantry, armored and mechanized brigades.



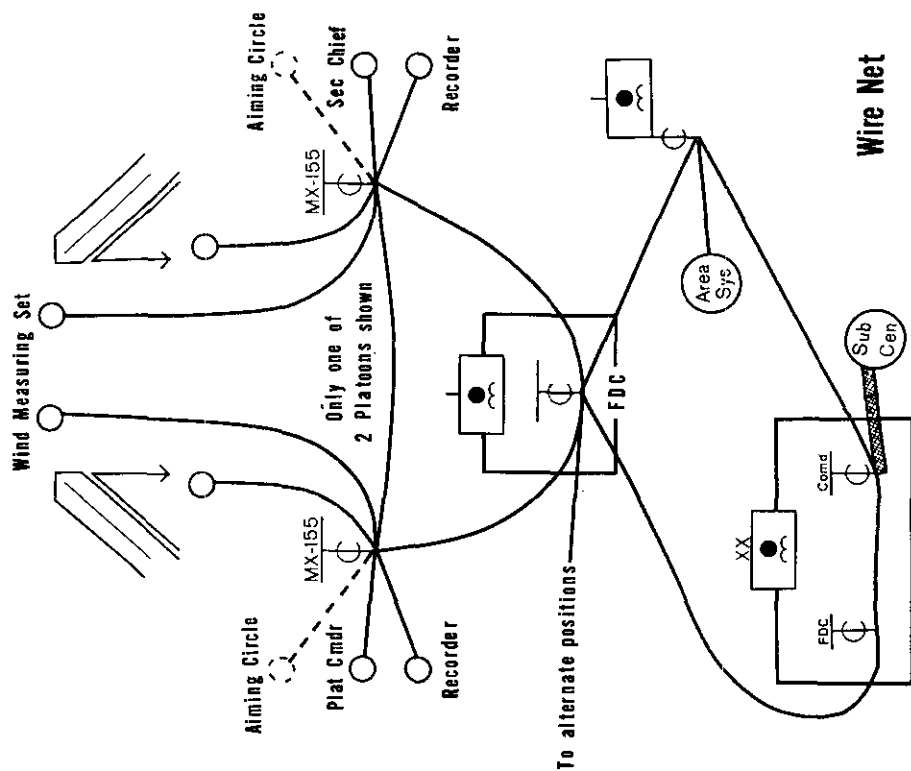
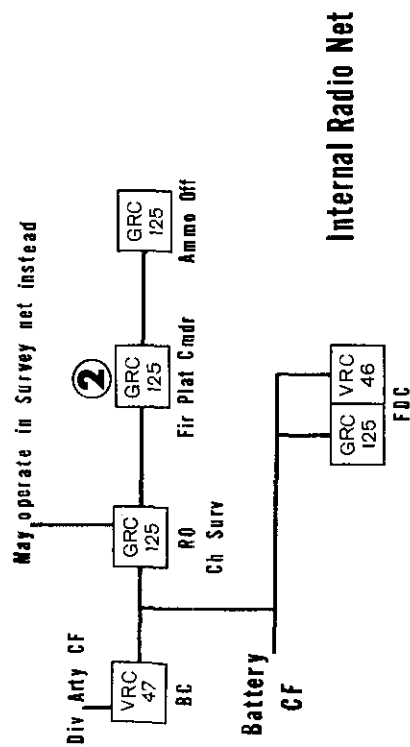
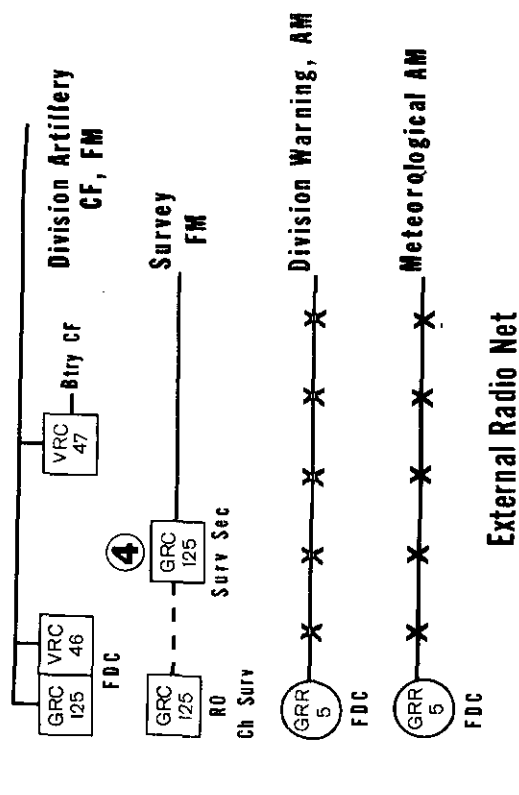


Figure 76. TOE 6-928E, field artillery battery, Little John, airborne division artillery.

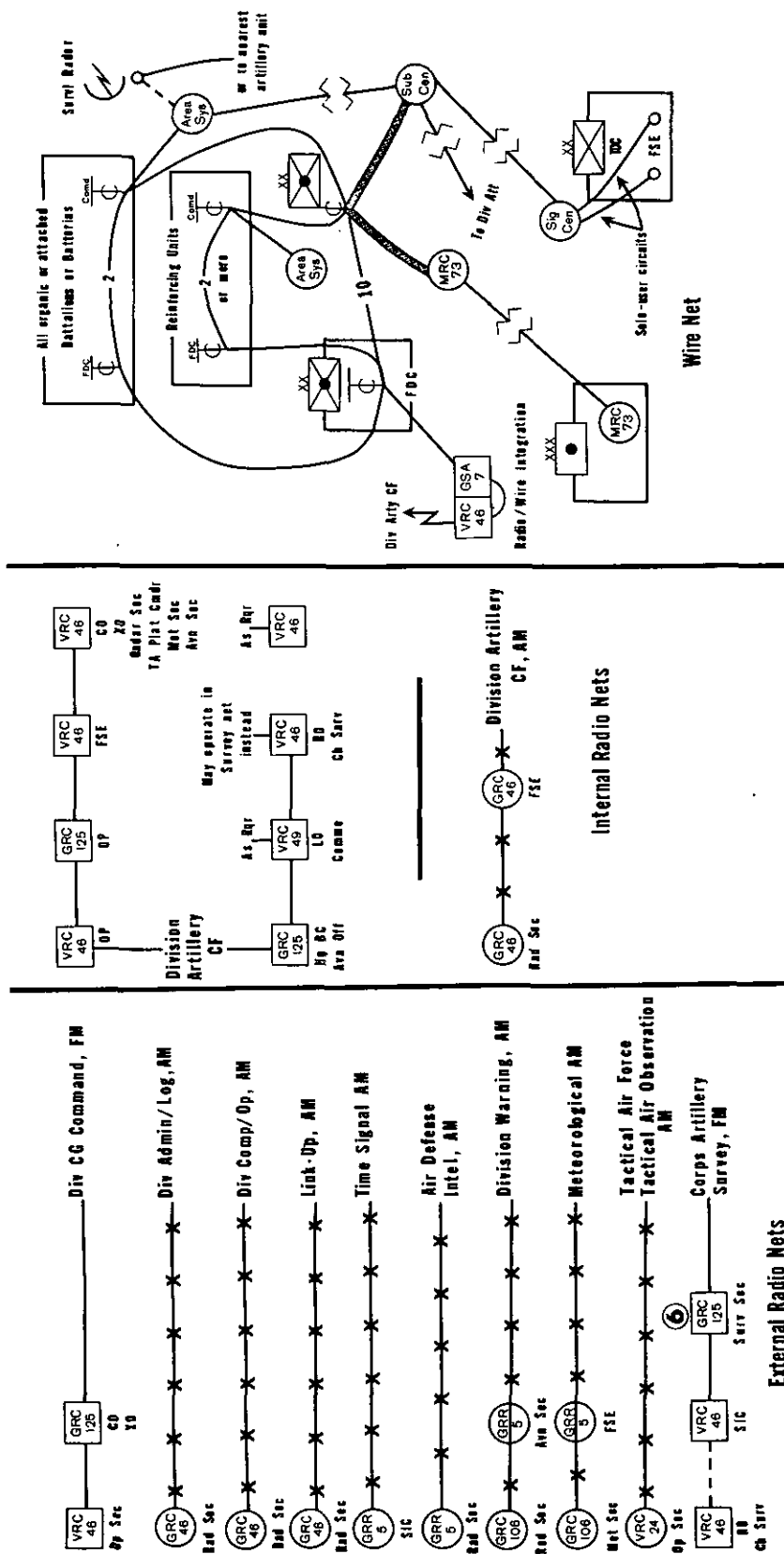


Figure 77. TOE 6-802E, division artillery.

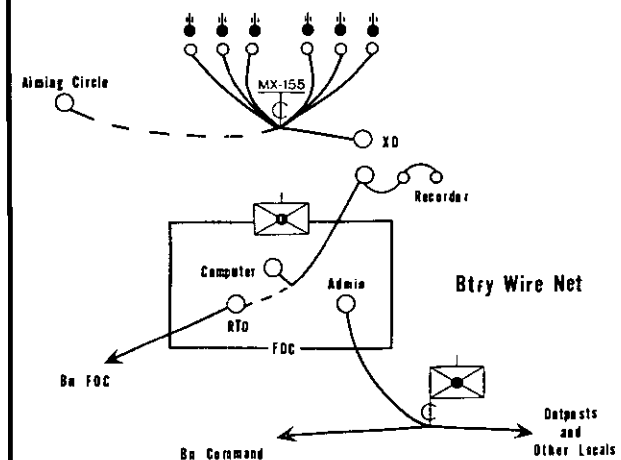
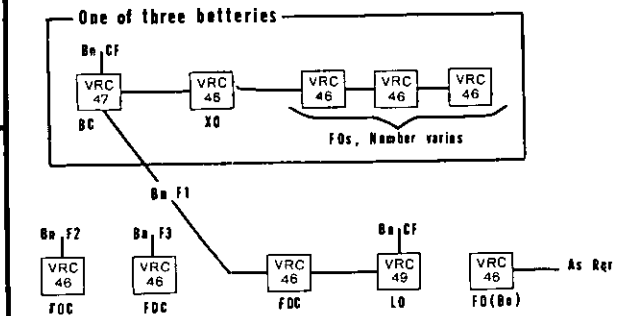
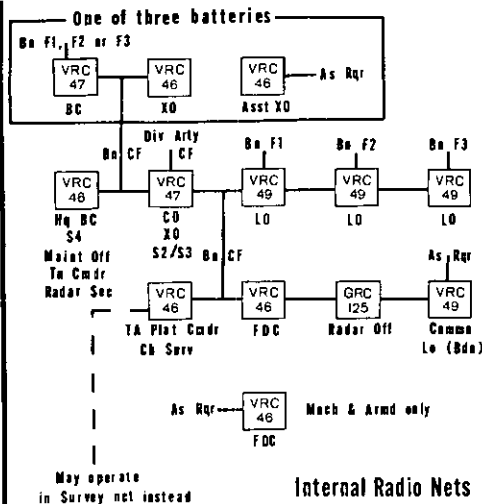
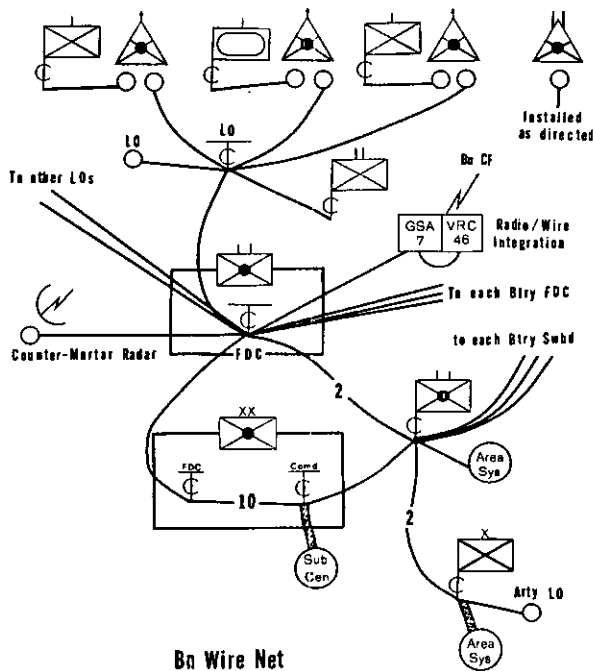
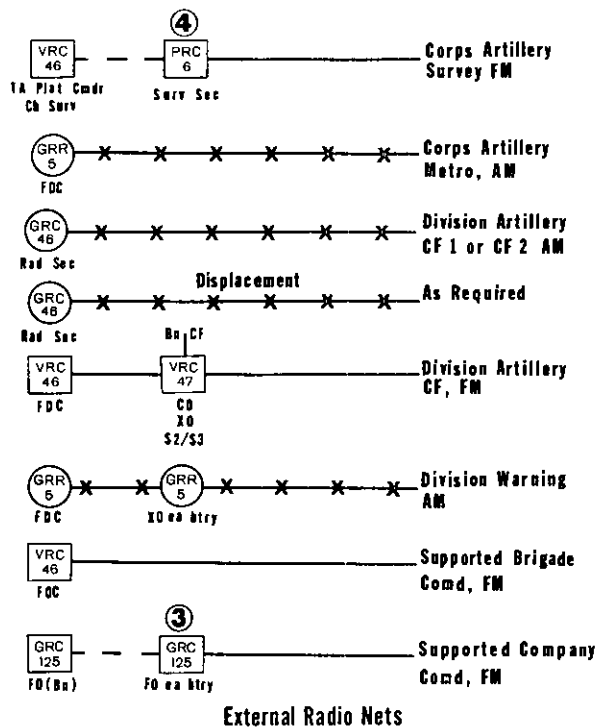
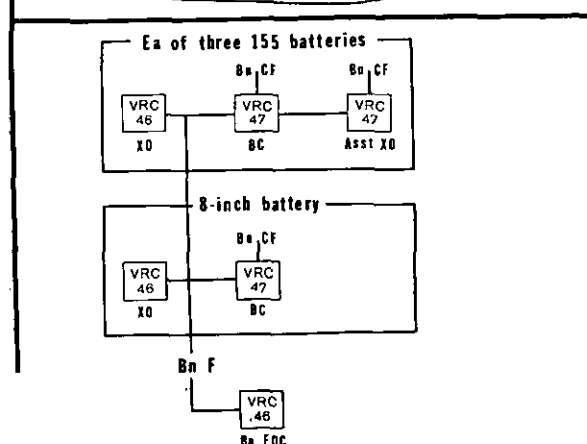
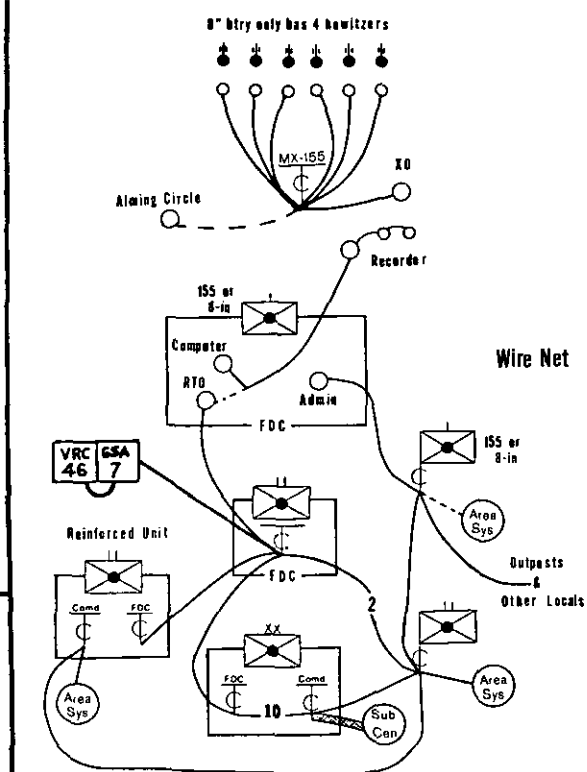


Figure 78. TOE 6-155E, 345E, and 365E, field artillery battalion, 105-mm and 155-mm, direct support, infantry, armored and mechanized division artillery.



Note 1:
This is a YRC-46 in Mech & Armd Div Arty

Note 2:
See additional VRC-46 (not shown) in Mech & Armd Div Arty

Internal Radio Nets

Figure 79. TOE 6-165E and 355E, field artillery battalion, 155-mm 8-inch, infantry armored, and mechanized division artillery.

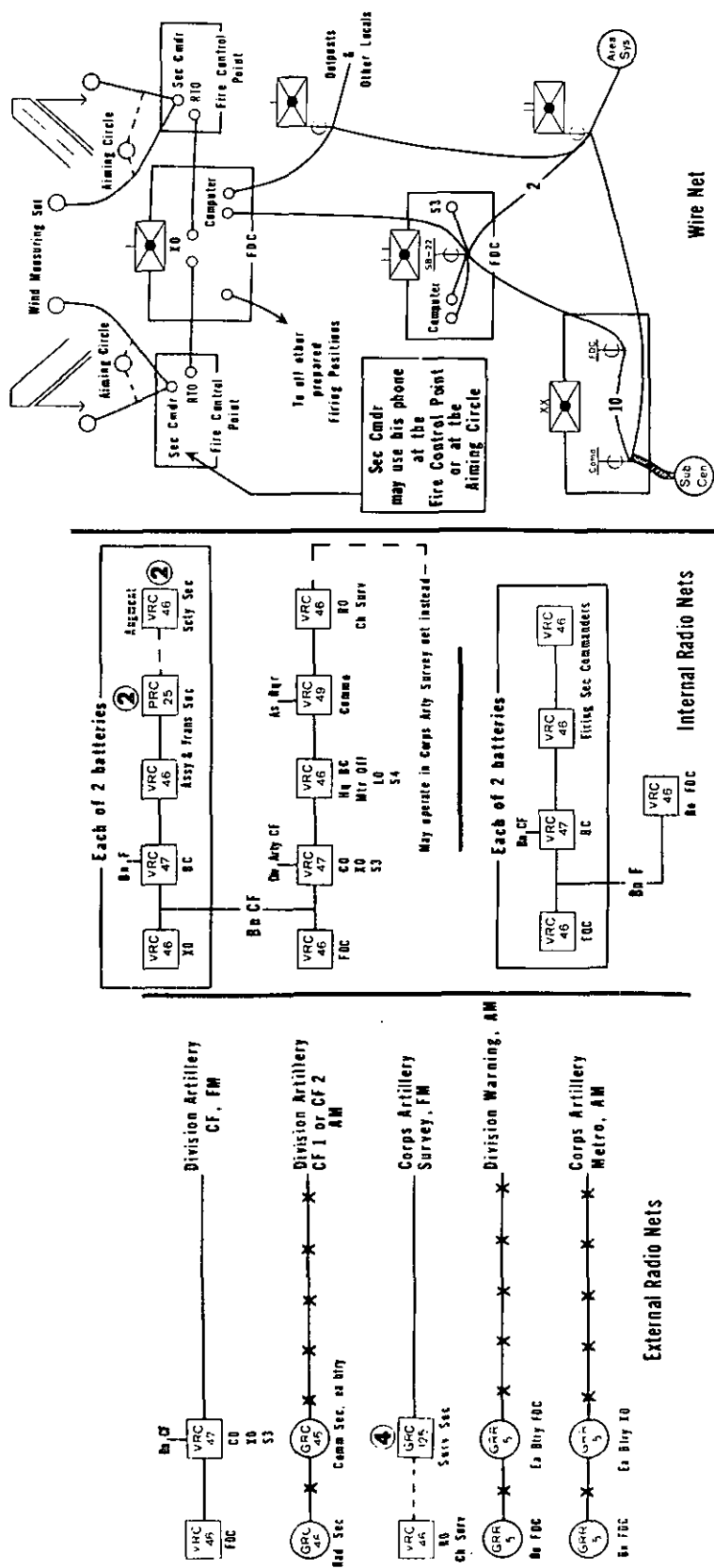


Figure 80. TOE 6-175E, field artillery battalion, Honest John and mechanized division artillery.

CHAPTER 15

SIGNAL MAINTENANCE

178. General

Maintenance for artillery communication equipment is a continuous operation. Preventive maintenance of radio and wire equipment is performed daily by the operator of the equipment. Organizational maintenance is prescribed by AR 750-5 (Organization, Policies, and Responsibilities for Maintenance Operations). Organizational maintenance is performed by personnel of artillery organizations and supervised by commanders and communication supervisors of all artillery commands. Specific instructions for the maintenance of any type of communication equipment are contained in the technical manual pertaining to the equipment. Proper maintenance of the complex signal equipment requires that the pertinent maintenance publications be in the hands of personnel charged with the responsibility for maintenance and that these personnel be instructed in the use and importance of the publications. It is the responsibility of each unit to determine what publications are needed, to requisition such publications, and to insure that the publications are used by maintenance personnel. A system of accounting for the documents should be adopted so that the publications are readily available to maintenance personnel.

179. Organizational Maintenance

Organizational maintenance is that maintenance normally authorized for, performed by, and the responsibility of, a using organization on the equipment in its possession. This maintenance consists of functions and repairs within the capabilities of authorized personnel, skills, tools, and test equipment as prescribed in the appropriate Department of the Army table of organization and equipment. (This function was formerly known as first- and second-echelon maintenance and will continue to appear as such in most maintenance publications until the publications are revised.) Maintenance exceeding the authorized scope may be performed

when authorized by the next higher maintenance support command.

180. Maintenance Responsibilities

a. *The Commander.* Responsibility is defined as an obligation to carry forward an assigned task to a successful conclusion. With responsibility goes the authority to direct and take the necessary action to insure success. Army regulations place the responsibility for maintenance on the commander of the unit or organization. Commanders are responsible for compliance with instructions and procedures for preventive maintenance procedures and for allocation of sufficient time for the performance of maintenance. Training in preventive maintenance is equal in importance to any other function of military training. Commanders are responsible for insuring that all equipment issued or assigned to them is maintained in a serviceable condition, that the equipment is properly cared for and used, and that maintenance and operating personnel comply with technical instructions. The principle of command responsibility should be inherent in every platoon leader and section leader and, in fact, in every man who has authority over another.

b. *The Supervisor.* A commander is not expected to know all the technical details related to the equipment assigned or issued to his unit. Officer and noncommissioned officer supervisors assist the commander in maintenance operations. These technical assistants, which could be referred to as the commander's special staff, provide the commander with technical guidance concerning the preventive maintenance program and assist him in conducting inspections and in planning and conducting preventive maintenance training. For example, if a field artillery battery commander wishes information on preventive maintenance techniques of radio sets, he would seek this information from a member of the communication platoon (communication chief or radio section chief). Although aided by the technical assistants, the commander cannot shift or

delegate command maintenance responsibility to his subordinates. This category of responsibility is referred to as supervisory responsibility, as distinguished from command responsibility.

c. *The Operator.* Some organizational maintenance is performed by the man or crew using the equipment. Such maintenance consists of inspecting, cleaning, servicing, preserving, and adjusting items of communication equipment used by an operator or a crew. These operations are *preventive maintenance* and are the "keystone" of the entire maintenance system. Such maintenance is performed daily on all equipment in use and weekly on equipment not in daily use. At the first sign of any defect in the equipment, the operator must alert his section chief or the organizational radio mechanic so that further deterioration may be checked.

d. *The Mechanic.* Other organizational maintenance is performed by trained organization mechanics. It consists of inspecting, adjusting, lubricating, testing, and replacing such parts as sub-assemblies, fuzes, and tubes. Definite limits to the extent of repairs to be performed by the organizational radio mechanic are prescribed in the maintenance allocation appendixes to technical manuals. Another limitation is imposed on the mechanic through the amount and type of test equipment and repair parts issued to the organization. Any piece of equipment with a maintenance problem beyond the scope of the organizational radio mechanic must be promptly evacuated to a higher echelon of main-

tenance. Such evacuation is accomplished through normal maintenance channels.

181. Parts Supply

The supply of repair parts and the resupply of spare part items for signal equipment is the most critical phase of organizational maintenance. A prescribed load list of repair parts must be maintained within the organization at all times. Communication equipment deadlined for lack of parts is a violation of all the principles of good maintenance. All artillery commanders and communication supervisors must constantly check this aspect of maintenance to insure that the authorized supply of parts is maintained within their organization. Major zone of interior (ZI) and oversea commanders will determine the number of prescribed loads of repair parts that units and organizations within their command may carry. Organizations required to have on hand boxed or packaged prescribed loads pursuant to a special mission assignment will compute or select the quantities separately from those quantities required for operating stocks at a permanent station. When stockage of repair parts is authorized, the computation of a prescribed load list will be based on information contained in part I (operator's manual) and part II (organizational maintenance manual) of the appropriate technical manual. If parts I and II of the technical manual have not been prepared, the prescribed list will be based on information contained in the appropriate SIG 7- and 8-series supply manual.

APPENDIX I

REFERENCES

1. Allied Communication Publications

(C) ACP 122(B)	Communication Instructions—Security (U).
(CM) ACP 125	Communication Instructions, Part V, Radiotelephone Procedure (U).
ACP 134	Telephone Switchboard Operating Procedure.

2. Department of Defense Publications, National Security Agency

(S) KAG-1/TSEC	Crypto Operation (U).
(S) KAG-21/TSEC	Instructions For Local Preparation of Cryptosystems For Tactical Use (U).
(CM) KAG-24/TSEC	Instructions For Preparation of Local Authentication Systems (U).

3. Army Regulations

AR 105-15	Army Field Commands.
AR 320-50	Authorized Abbreviations and Brevity Codes.
AR 345-210	Records Management, Files Systems and Standards.
AR 380-5	Safeguarding Defense Information.
AR 380-6	Automatic, Time-Phased Downgrading and Declassification System.
AR 380-40	Safeguarding Crypto-Information.
(CM) AR 380-40-1	Safeguarding Crypto-Information (Supplement) (U).
AR 380-41	Control Of Cryptomaterial.
(S) AR 380-46	Restrictions On The Use of Information Processing Equipment (U).
AR 604-5	Clearance Of Personnel For Access To Classified Defense Information and Material.
AR 750-5	Organization, Policies and Responsibilities For Maintenance Operations.

4. Joint Army Navy Air Procedures

JANAP-164	Joint Radiotelephone Procedure For The Conduct of Artillery and Naval Gun Fire.
(C) JANAP-201	Status of Noncryptographic JANAPs and ACPs (U).

5. Field Manuals

FM 6-20-1	Field Artillery Tactics.
FM 6-20-2	Field Artillery Techniques.
FM 11-50	Signal Battalion, Armored, Mechanized and Infantry Divisions.
FM 11-57	Signal Battalion, Airborne Division.
FM 11-92	Corps Signal Battalion, Army.
FM 17-59	The Armored Cavalry Regiment.
FM 21-60	Visual Signals.
FM 24-16	Signal Orders, Records and Reports.
FM 24-17	Tactical Communications Center Operations.
FM 24-18	Field Radio Techniques.

FM 24-20
(CM) FM 32-5
FM 100-11
FM 101-5

Field Wire And Field Cable Techniques.
Communications Security (U).
Signal Communications Doctrine.
Staff Officers Field Manual, Staff Organization and Procedure.

6. Technical Manuals

TM 11-286
TM 11-287
TM 11-295
TM 11-381

TM 11-611
TM 11-678
TM 11-2059
TM 11-2134
TM 11-2155
TM 11-2240
TM 11-3895-209-12 & 20P
TM 11-4065
TM 11-5038
TM 11-5805-243-12 & 20P
TM 11-5805-262-12 & 20P
TM 11-5805-303-20P
TM 11-5815-204-10, 20 & 20P

TM 11-5815-206-12 & 20P

TM 11-5820-292-10, 20 & 20P
TM 11-5820-295-10, 20 & 20P
TM 11-5820-398-10
TM 11-5820-401-10

TM 11-5820-469-10
TM 11-5820-477-12
TM 11-6625-496-12
TM 38-750

Radio Sets, AN/VRC-8, -9, and -10.
Radio Sets, AN/VRQ-1, -2, and -3.
Radio Receiving Set, AN/GRR-5.
Cable Assembly, CX-1065/G, Telephone Cable Assemblies CX-1606/G and CX-1512/U, And Telephone Loading Coil Assembly CU-260/G and Electrical Connection Plug U-176/G.
Radio Sets AN/VRC-16, -17, and -18.
Fundamentals of Telephony.
Telephone Set TA-264/PT and Telephone TP-9.
Manual Telephone Switchboard SB-86/P, Installation and Operation.
Telephone Set TA-312/PT.
Wire Dispenser MX-306A/G.
Reeling Machine, Cable, Engine Driven, RL-207/G.
Radio Sets AN/PRC-8, -9, and -10, Field Maintenance.
Control Group, AN/GRA-6.
Telephone Set, TA-1/PT.
Switchboard, Telephone, Manual, SB-22/PT And SB-22A/PT.
Connecting And Switching Kit, MX-155/GT.
Radio Teletypewriter Sets, AN/GRC-46, -46A, -46B, and AN/VRC-29.
Teletypewriter Set, AN/PGC-1 and Teletypewriters TT-4A/TG, TT-4B/TG, TT-4C/TG and TT-335/TG.
Radio Sets, AN/PRC-8, -8A, -9, -9A, -10, -10A, and -28.
Radio Set, AN/GRC-19.
Radio Set, AN/PRC-25.
Radio Sets, AN/VRC-12 and AN/VRC-43, -44, -45, -46, -47, -48, and -49.
Radio Terminal Set, AN/TRC-80.
Radio Set Control Group AN/GRA-39.
Test Set, Radio, AN/VRM-1.
Army Equipment Record Procedures.

APPENDIX II

SYMBOLS

1. Short Titles for Radio Nets

The short titles shown in figure 81 are used in conjunction with artillery radio net diagrams and the discussions of radio nets. Frequency modulated (FM) nets are shown by a solid line, amplitude (AM) nets are shown by a solid line on which a series of X's are superimposed at convenient intervals.

Suffix numbers are added to the short titles if more than one net is used for the same purpose; i.e., F1, F2, F3 if a unit has three fire direction nets.

2. Basic Communication Symbols

The basic communication symbols are shown in figure 82.

FM Nets	Purpose	AM Nets
—— CF ——	Command Fire Direction	— x — CF — x —
—— F ——	Fire Direction	— x — F — x —
—— CI ——	Command Intelligence	— x — CI — x —
—— CL ——	Command Light Direction	
—— R ——	Sound Ranging	
—— T ——	Flash Ranging	
—— S ——	Survey	
	Meteorological	— x — M — x —
—— LN ——	Liaison	— x — LN — x —
—— CO ——	Command Operations	— x — CO — x —
- - - - -	Alternate Net (or net of secondary interest)	- x - - - - x -

Figure 81. Short titles for radio nets.

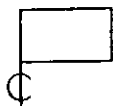
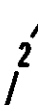
Repeating coil (Simplex coil) on a line circuit		Not always provided	
Wire circuit with telephone set TA-312/ PT		Telephone switching central at a command post or headquarters	
Remote control unit for radio		Radar station	
Wire circuit, indicating number of pairs available		Telephone switching central at a command post or headquarters	
Telephone		Teletype facilities	
Page Printer		Reperforator	
Multi-channel cable		Signal center, operated by signal unit	
FM Radio		AM Radio	

Figure 82. Communication symbols.

INDEX

	Paragraph	Page		Paragraph	Page
Antenna:			Duties—Continued		
Field expedients	171	89	Communication officer	29	8
Group RC-292	170	89	Message clerk	34	9
Area communication systems	7	4	Radio section chief	37	10
Assistant communication officer:			Senior message clerk	33	9
Duties	30	9	Wire section chief	35	9
Relationships	31	9	Wire team chief	36	9
Authentication:			Establishing communication respon-		
Challenge and reply	77	20	sibility	46-53	13
General	74	19	Field message	85-88	24
Net	78	20	Field telephones, general	133	63
Procedures	75	19	Five-pair cable	121	53
Transmission	77	20	Headquarters battery commander,		
Battery communication sections	28	8	relationship with	31	9
Cable reeling machine:			Installation of artillery communica-		
Engine driven, RL-207	129	60	tion systems	8	4
Hand:			Integration of wire and radio com-		
RL-27	126	58	munication	45	13
RL-31	127	59	Internal communication	51	13
Motor driven, RL-172/G	128	59	Introduction	6	4
Chief message clerk, duties	33	9	Jamming	71	18
Climbers, LC-240/U	131	61	Lateral communication	50	13
Communication:			Lineman's belt LC-23	132	63
Chief, duties	32	9	Line route map	115	50
During:			Maintenance:		
Attack	17	6	Of communication	52	13
Defense	20, 21	6	Organizational	179	121
Marches and halts	12, 13	5	Responsibilities	180	121
Pursuit	19	6	Manual telephone switchboard:		
Reorganization	18	6	General	137	65
Retrograde movements	22-24	7	SB-22/PT	139	66
Internal	51	13	SB-993/GT	138	65
In assembly areas	10, 11	5	Message:		
Lateral	50	13	Book	87	24
Messenger	42	12	Center operation	89-98	28
Officer	29, 31	8, 9	Clerk, duties	34	9
Planning	9	4	Incoming	96-98	34
Platoons	26	8	Outgoing	94, 95	33
Principles	46-53	13	Preparation	68	17
Radio	41	12	Messenger communication	42	12
Requirements	28, 43, 44, 54-56, 175	8, 12, 13, 15, 94	Monitoring	73	19
System	40, 172-177	11, 94	Nets, wire and radio	181	122
Teams	38	10	Operation order	79	22
Control group AN/GRA-6	166	85	Operator:		
Cryptographic security	58-61	16	Maintenance	180	121
Duties:			Training	70	18
Assistant communication officer	30	9			
Chief message clerk	33	9			
Communication chief	32	9			

	Paragraph	Page		Paragraph	Page
Organizational.....	179	121	Security—Continued		
Physical security.....	62-65	17	General, communication.....	54-57	15
Planning, communication.....	9	4	Physical.....	62-65	17
Principles of communication.....	51, 53	13	Telephone.....	72	19
Procedures for radio-wire integration.....	106-108	44	Transmission.....	66-73	17
Radio:			Senior message clerk, duties.....	33	9
And wire integration.....	45	13	Signal:		
Communication.....	41	12	Annex.....	80	22
Equipment.....	145-171	69	Maintenance, general.....	178	121
Intelligence.....	69	18	Operation instructions.....	82	23
Nets.....	174, 176	94	Sound communication.....	44	13
Section chief, duties.....	37	10	Spiral-four cable.....	122	54
Receiver R-442/VRC.....	155	80	Splicing equipment.....	123	55
Receiver-transmitter RT-246/VRC.....	156	80	Standing operating procedure.....	81	22
Receiver-transmitter RT-524/VRC.....	157	80	Standing signal instructions.....	83	23
Receiver-transmitter RT-505/PRC.....	163	83	Superior to subordinate.....	47	13
Set			Supporting to supported.....	48	13
AN/GRR-5.....	146	69	Switchboard procedure.....	112	48
AN/GRC-19.....	147	70	Symbols.....	app. II	125
AN/GRC-125.....	162	82	Systems, area communication.....	8	4
AN/PRC-8, -9, -10.....	150	72	Telephone:		
AN/PRC-25.....	162	82	Directory.....	110	47
AN/VRC-9.....	151	76	Operation.....	111	47
AN/VRC-12, -43, -49.....	154	78	Procedure.....	109-112	47
AN/VRC-17.....	152	77	Security.....	72	19
AN/VRC-24.....	149	72	Set:		
AN/VRC-46.....	160	81	TA-1/PT.....	134	63
AN/VRC-47.....	159	80	TA-264/PT.....	136	64
AN/VRC-49.....	161	81	TA-312/PT.....	135	63
AN/VRC-53.....	162	82	Wire:		
AN/VRQ-2.....	153	77	Reels.....	124	57
Control, AN/GSA-7.....	168	88	WD-1/TT.....	120	53
Control, AN/GRA-39.....	167	86	Teletypewriter set:		
Teletypewriter set:			AN/PGC-1.....	142	68
AN/GRC-46.....	148	72	General.....	141	67
Terminal AN/TRC-80.....	165	83	Terminal:		
Test AN/VRM-1.....	159	80	Board TM-184.....	143	68
Radiotelephone procedure—conduct of fire.....	99-105	35	Telephone switchboard SB-86/P.....	140	66
Reinforcing to reinforced.....	49	13	Traffic diagram.....	113, 114	50
Repair parts supply.....	181	122	Transmission security.....	66-73	17
Repeating coils.....	144	69	Wire:		
Routine signal orders.....	84	23	And radio integration.....	45	13
Security:			Communication.....	40	11
Cryptographic.....	58-61	16	Dispenser MX-306A/G.....	125	58
			Equipment.....	119-144	55
			Pike MC-123.....	130	61
			Section chief duties.....	35	9
			System.....	173	94
			Team chief duties.....	36	9

By Order of the Secretary of the Army:

HAROLD K. JOHNSON,
*General, United States Army,
Chief of Staff.*

Official:

J. C. LAMBERT,
*Major General, United States Army,
The Adjutant General.*

Distribution:

Active Army:

DCSPER (2)
DCSLOG (2)
DCSOPS (2)
ACSI (2)
CORC (2)
COA (1)
CNGB (2)
CRD (1)
TIG (1)
CINFO (1)

USCONARC (5)
LOGCOMD (1)
USACDC (2)
MDW (3)
Armies (5)
Corps (3)
Corps Arty (10)
Div (2)
Bde (5)

FA Gp (5)
FA Bn (5)
FA Btry (5)
USACGSC (30)
Br Svc Sch (5) except
USAAMS (35)
USAIS (33)
USAARMS (30)
USASCS (30)

NG: State AG (3); FA Div Arty (2); FA Corps Arty (2); FA Gp (2); FA Bn (2) except TOE's: 6-155 (3), 6-165 (3), 6-175 (3), 6-345 (3), 6-355 (3), 6-365 (3), 6-415 (3), 6-425 (3), 6-575 (3); FA Btry (2) except TOE's: 6-302 (3), 6-401 (3), 6-501 (3).

USAR: Same as active Army except allowance is one copy to each unit.

For explanation of abbreviations used, see AR 320-50.

☆ U.S. Government Printing Office: 1965--750509